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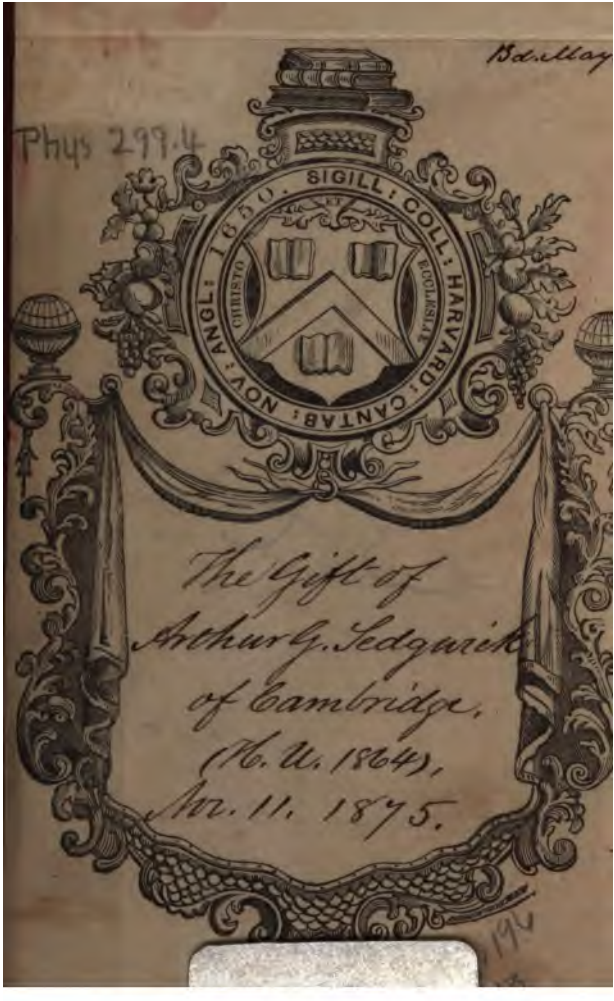

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——— *on Glass by the Rays of the Sun* . .

GUY JOHNSON
2300 CANOSA AVE.
LAS VEGAS, NEVADA 8910

ENDLESS

AMUSEMENT.

To produce Fire by the Mixture of two cold Liquids.

TAKE half a pound of pure dry nitre, in powder, put it in a retort that is quite dry; add an equal quantity of highly rectified oil of vitriol, and distilling the mixture in a moderate sand heat, it will produce a liquor like a yellowish fume; this, when caught in a dry receiver, is *Glauber's Spirits of Nitre;* probably the preparation under that name, may be obtained at the chemist's, which will of course save much time and trouble.

You then put a drachm of distilled oil of cloves, turpentine, or carraways in a glass vessel; and if you add an equal quantity, or rather more of the above spirit, though both are in themselves perfectly cold, yet on mixing them together, a great flame will arise and destroy them both, leaving only a little resinous matter at the bottom.

The Exploding Bubble.

If you take up a small quantity of melted glass with a tube, (the bowl of a common tobacco pipe will do,) and let a drop fall into a vessel of water, it will chill and condense with a fine spiral tail, which being broken, the whole substance will burst with a loud explosion, without injury either to the party that holds it, or him that breaks it; but if the *thick* end is struck even with a hammer, it will not break.

The Magic Picture.

Take two level pieces of glass, (plate glass is the best,) about three inches long and four wide, exactly of the same size; lay one on the other, and manage to leave a space between them by pasting a piece of card, or two or three small pieces of thick paper at each corner.

Join these glasses together at the edges by a composition of lime slacked by exposure to the air, and white of an egg. Cover all the edges of these glasses with parchment or bladder, except at one end, which is to be left open to admit the following composition:

Dissolve by a slow fire six ounces of hog's-lard, with half an ounce of white wax; to which you may add an ounce of clear linseed oil.

This must be poured in its liquid state, and before a fire, between the glasses, by the space left in the sides, and which you are then to close up. Wipe the glasses clean, and hold them before the fire, to see that the composition will not run out at any part.

Then fasten with gum a picture or print, painted on very thin paper, with its face to one of the glasses, and if you like, you may fix the whole in a frame.

While the mixture between the glasses is cold, the picture will be quite concealed, but become transparent when held to the fire; and as the composition cools, it will gradually disappear.

Artificial Lightning.

Provide a tin tube that is larger at one end than it is at the other, and in which there are several holes. Fill this tube with powdered resin; and when it is shook over the flame of a torch, the reflection will produce the exact appearance of lightning.

Artificial Thunder.

Mix two drachms of the filings of iron, with one ounce of concentred spirit of vitriol, in a strong bottle that holds about a quarter of a pint; stop it close, and it

few minutes shake the bottle; then taking out the cork, put a lighted candle near its mouth, which should be a little inclined, and you will soon observe an inflammation arise from the bottle, attended with a loud explosion.

To guard against the danger of the bottle bursting, the best way would be to bury it in the ground, and apply the light to the mouth by means of a taper fastened to the end of a long stick.

Another Way.

Mix three ounces of saltpetre, two ounces of salt of tartar, and two ounces of sulphur; roll the mixture up into a ball, of which take a quantity, about the size of a hazel nut, and placing it in a ladel or shovel over the fire, the explosion will resemble a loud clap of thunder.

You will produce a much more violent commotion if you double or treble the quantity of the last experiment; suppose you put two or three ounces of the mixture into the shovel. For fear of accidents, it should not be done in the house, but by placing the shovel over a chaffing dish of very hot coals, and performing the experiment in the open air, standing a great distance off.

Common prudence will dictate the necessity of using great care in the above experiments, as an accident will soon happen, if a person does not use great precaution in getting out of the way before the composition explodes.

Money augmented by an Optical Illusion.

In a large drinking glass of a conical shape, (small at the bottom and wide at the top,) put a shilling, and let the glass be half full of water; then place a plate on the top of it, and turn it quickly over, that the water may not escape. You will see on the plate a piece of coin, the size of half a crown; and a little higher up another the size of a shilling.

It will add to the amusement this experiment affords, by giving the glass to any one in company, (but who of course has not witnessed your operations,) and desiring

him to throw away the water, but save the two piec
he will not be a little surprised at finding only one.

Three Objects, discernible only with both Eyes.

If you fix three pieces of paper against the wall
room at equal distances, at the height of your eye, pl
ing yourself directly before them, at a few yards'
tance, and close your right eye, and look at them w
your left, you will see only two of them, suppose the f
and second; alt the position of your eye, and
will see the first and third; alter your position a sec
time, you will see the second and third, but never
whole three together; by which it appears, that a p
son who has only one eye can never see three obje
placed in this position, nor all the parts of one object
the same extent, without altering the situation of his e

To construct the Camera Obscura.

Make a circular hole in the shutter of a window fr
whence there is a prospect of some distance; in this h
place a magnifying glass, either double or single, wh
focus is at the distance of five or six feet; no light m
enter the room but through this glass. At a distar
from it, equal to its focus, place a very white pasteboa
(what is called a Bristol board, if you can procure c
large enough; will answer extremely well;) this bo
must be two feet and a half long, and eighteen or twe
inches high, with a black border round it: bend
length of it inward to the form of part of a circle, wh
diameter is equal to double the focal distance of
glass. Fix it on a frame of the same figure, and put it
a moveable foot, that it may be easily placed at that d
tance from the glass, where the objects appear to t
greatest perfection. When it is thus placed, all the
jects in front of the window will be painted on t
paper in an inverted position, with the greatest regul
ty, and in the most natural colours. If you place a swi
looking-glass outside the window, by turning it more

less, you will have on the paper all the objects on each side the window.

If, instead of placing the looking-glass outside the window, you place it in the room above the hole which must then be made near the top of the shutter,) you may have the representation on a paper placed horizontally on a table, and draw at your leisure all the objects reflected.

Observe, the best situation is directly north; and the best time of the day is noon.

The Magnifying Reflector.

Let the rays of light that pass through the magnifying glass in the shutter be thrown on a large concave mirror, properly fixed in a frame. Then take a thin strip of glass, and stick any small object on it; hold it in the intervening rays at a little more than the focal distance from the mirror, and you will see on the opposite wall, amidst the reflected rays, the image of that object, very large, and beautifully clear and bright.

To tell by a Watch Dial, the Hour when a Person intends to rise.

The person is told to set the hand of his watch at any hour he pleases, which hour he tells you; and you add in your own mind 12 to it. You then desire him to count privately the number of that addition on the dial, commencing at the next hour to that at which he intends to rise, and including the hour at which he has placed the hand; which will give the answer: for example,

A intends to rise at 6, (this he conceals to himself;) he places the hand at 8, which he tells B, who, in his own mind, adds 12 to 8, which make 20. B then tells A to count 20 on the dial, beginning at the next hour to that at which he proposes to rise; which will be 7, and counting backwards, reckoning each hour as 1, and including in his addition the number of the hour the hand is placed

at, the addition will end at 6, which is the hour posed ; thus,

The hour the hand is placed at is - - - - - - - - -

The next hour to that which A intends to rise at is 7, which counts for - - - - - - - - - - - - - - -

Count back the hours from 6, and reckon them at 1 each, there will be 11 hours, viz. 4, 3, 2, 1, 12, 11, 10, 9, 8, 7, 6, - - - - - - - - - - - - - - - - - -

Making - - - - - - -

A person having an even number of shillings in one hand an odd number in the other, to tell in which hand the od even number is.

You desire the person to multiply the number in right hand by an odd figure, and the number in his left an even one ; and tell you if the products added togetl be odd or even. If even, the even number is in the ri hand ; if odd, the even number is in the left. For instar

I. Number in the right hand is *even* - - - - 18	In the left hand *odd* - - -
Multiply by - - - - - - 3	Multiply by - - - - -
Product - - - 54	Product - - - -
Add the Product of the left hand - - - 14	
Which produces a total of - - - - - - 68	

II. Number in the right hand is *odd* - - - - 7	In the left hand *even* - - -
Multiply by - - - - - 3	Multiply by - - - - -
Product - - - - 21	Product - - - -
Add the Product of the left hand - - 36	
Which produces a total of - - - - - 57	

Secret Correspondence.

To carry on a correspondence, without the possibility of the meaning of the letter being detected, in case it should be opened by any other person, has employed the ingenuity of many. No method will be found more effectual for this purpose, or more simple, than the following.

Provide a piece of square card or pasteboard, (see Fig. 1 in the frontispiece) and draw a circle on it, which circle is to be divided into 27 equal parts, in each of which parts must be written *one* of the capital letters of the alphabet, and the &, as in the figure. Let the centre of this circle be blank. Then draw another circle, also divided into 27 equal parts, in each of which write one of the small letters of the alphabet and the &. This circle must be cut round, and made exactly to fit in the blank space in the centre of the larger circle, and must run round a pivot or pin. The person with whom you correspond must have a similar dial, and at the beginning of your letter you must put the capital letter, and at the end the small letter, which answer to each other when you have fixed your dial.

Suppose what you wish to communicate is as follows:

I am so watched I cannot see you as I promised; but I will meet you to-morrow in the park, with the letter, &c.

You begin with the letter *T*, and end with the letter *m*, which shews how you have fixed the dial, and how your correspondent must fix his, that he may decipher your letter. Then, for *I am*, you write *b uf*, and so of the rest, as in the frontispice.

Another Way.

Take two pieces of card, pasteboard, or stiff paper, through which you cut long squares at different distances. One of these you keep yourself, and the other you give to your correspondent. You lay the pasteboard on a paper, and in the spaces cut out, write what you would have understood by him only; then fill the intermediate spaces with any words that will connect the whole together and make a different sense. When he receives it, he la

his pasteboard over the whole, and those words wh between crotchets [ ] form the intelligence you communicate. For example; suppose you want to these words:

"*Don't trust Robert: I have found him a villai*

"[Don't] fail to send my books. I [trust] they ready when [Robert] calls on you. [I have] hea you have [found] your dog. I call [him a villai stole him." You may place a pasteboard of th three other ways,—the bottom at top,—the top at l or by turning it over; but in this case you must pre apprize your correspondent, or it may give him som ble to decipher your meaning.

Secret Correspondence by Music.

Form a circle like Fig. 2, divided into twenty-si with a letter of the alphabet written in each. The i of the circle is moveable, like that in Fig. 1, a circumference is to be ruled like music paper. P each division a note different in figure or position.

Within the musical lines place the three keys, the outer circle the figures to denote time. Ther ruled paper, and place one of the keys, (suppose *ge* against the time, 2-4ths, at the beginning of the which will inform your correspondent how to pl circle. You then copy the notes that answer to the of the words you intend to write, in the manner exp at the bottom of the figure.

The Magic Vessel.

On the bottom of a vessel, (see Fig. 3 in the F piece,) lay three pieces of money, the first at A, the at B, and the third at C. Then place a person at D, he can see no further into the vessel than E. You te that by pouring water in the vessel you will make h three different pieces of money; and bid him ob that you do not convey any money in with the water, *be careful* that you pour the water in very gently,

pieces will move out of their places, and thereby destroy the experiment.

When the water rises up to F. the piece at A will be visible; when it reaches G, both A and B will be visible; and when it comes up to H, all three pieces will be visible.

Artificial Earthquake and Volcano.

Grind an equal quantity of fresh iron filings with pure sulphur, till the whole be reduced to a fine powder. Be careful not to let any wet come near it. Then bury about thirty pounds of it a foot deep in the earth, and in about six or eight hours the ground will heave and swell, and shortly after send forth smoke and flames like a burning mountain. If the earth is raised in a conical shape, it will be no bad miniature resemblance of one of the burning mountains.

Artificial Illumination.

A very pleasing exhibition may be made with very little trouble or expense, in the following manner: Provide a box, which you fit up with architectural designs cut out on pasteboard; prick small holes in those parts of the building where you wish the illuminations to appear, observing, that in proportion to the perspective, the holes are to be made smaller; and on the near objects the holes are to be made larger. Behind these designs thus perforated, you fix a lamp or candle, but in such a manner, that the reflection of the light shall only shine through the holes; then placing a light of just sufficient brilliance to shew the design of the buildings before it, and making a hole for the sight at the front end of the box, you will have a very tolerable representation of illuminated buildings.

The best way of throwing the light in front is to place an oiled paper before it, which will throw a mellow gleam on the scenery, and not diminish the effect of the illumination. This can be very easily planned, both not to obstruct the sight, nor be seen to disadvantage. The

lights behind the picture should be very strong; and if a magnifying glass were placed in the sight-hole, it would tend greatly to increase the effect. The box must be covered in, leaving an aperture for the smoke of the Lights to pass through.

The above exhibition can only be shown at candle-light; but there is another way, by fixing small pieces of gold on the building instead of drilling the holes, which gives someting like the appearance of illumination, but by no means equal to the foregoing experiment.

N. B. It would be an improvement if paper of various colours, rendered transparent by oil, were placed between the lights behind, and the apertures in the buildings, as they would then resemble lamps of different colours.

The Cameleon Spirit.

Put into a decanter, volatile spirit, in which you have dissolved copper filings, and it will produce a fine blue. If the bottle is stopped, the colour will disappear; but when unstopped, it will return. This experiment may be often repeated.

Invisible Ink.

Put litharge of lead into very strong vinegar, and let it stand twenty-four hours. Strain it off, and let it remain till quite settled; then put the liquor in a bottle.

You next dissolve orpiment in quick lime water, by setting the water in the sun for two or three days, turning it five or six times a day. Keep the bottle containing this liquor well corked, as the vapour is highly pernicious if received into the mouth.

Write what you wish with a pen dipped in the first liquor; and to make it visible, expose it to the vapour of the second liquor. If you wish them to disappear again, draw a sponge or pencil, dipped in aquafortis, or spirit of nitre, over the paper; and if you wish them to re-appear, let the paper be quite dry, and then pass the solution of orpiment over it.

Another.

Dissolve bismuth in nitrous acid. When the writing with this fluid is exposed to the vapour of liver of sulphur, it will become quite black.

Another.

Dissolve green vitriol and a little nitrous acid in common water. Write your characters with a new pen.

Next infuse small Aleppo galls, slightly bruised, in water. In two or three days, pour the liquor off.

By drawing a pencil dipped in this second solution over the characters written with the first, they will appear a beautiful black.

Invisible Gold Ink.

Put as much gold in as small a quantity of aqua regia as will dissolve it, and dilute it with two or three times the quantity of distilled water.

Next dissolve, in a separate vessel, fine pewter in aqua regia, and when it is well impregnated, add an equal quantity of distilled water.

Write your characters with the first solution; let it dry in the shade. To make them appear, draw a pencil or sponge, dipped in the second solution, over the paper, and the characters will appear of a purple colour.

Invisible Silver Ink.

Dissolve fine silver in aqua fortis; and after the dissolution, add some distilled water in the same manner as in the gold ink.

What is written with the above ink will remain invisible for three or four months if kept from the air; but may be easily read in an hour, if exposed to the fire, air, or sun.

Invisible Yellow Ink.

STEEP marygold flowers seven or eight days in distilled vinegar. Press the flowers and strain the li which is to be kept in a bottle well corked. I would have it still more clear, add, when you use it, pure water.

To make the characters visible, which you write this ink, pass a sponge over the paper, dipped i following solution:

Take a quantity of flowers of pansy, or the com violet, bruise them in a mortar with water, strain the li in a cloth, and keep it in a bottle.

Invisible Red Ink.

To the pure spirit of vitriol or nitre, add eight tim much water.

Use the above solution of violets to make visibl characters written with this ink.

Invisible Green Ink.

DISSOLVE salt of tartar, clear and dry, in a suffi quantity of river water. Use the violet solution to re it visible.

Another Invisible Green Ink.

DISSOLVE zaffre in powder, in aqua regia, for twe four hours. Pour the liquor off, add the same qua ofcommon water, and keep it in a bottle well corke

This ink will not be visible till exposed to the fi the sun; and will again be invisible when it becc cold.

Invisible Violet Ink.

EXPRESS the juice of lemons, and keep it in a b well corked. Use the violet infusion to make the wri visible.

Invisible Grey Ink.

Mix alum with lemon juice. The letters written with this ink will be invisible till dipped in the water.

We now present our readers with a variety of amusing experiments, which may be performed by the foregoing inks; and they will, probably, suggest others equally amusing and useful.

A Secret Correspondence by means of Invisible Ink.

A person wishing to carry on a correspondence with another, and who is fearful of having his letter opened or intercepted, can adopt the following plan:

Write any unimportant matter with common ink, and let the lines be very wide apart: then between these lines, write the communication you wish to make, with any of the above invisible inks you can most readily procure.

Your correspondent is to be previously apprized of the method of making the characters visible; and writing in common ink will serve to lull the suspicions of those who might intercept the letter; and who not finding any thing important in it, will either forward or keep it. In either case there can be no danger, as the writing will not be visible without the proper application.

The Mysterious Writing.

Write on a piece of paper with common ink any question: then underneath it write the answer either in invisible silver ink, or the invisible green ink, made with zaffre and aqua regia, described in pages 22 and 23.

You give this paper to your friend, and tell him to place it against the wall, or on his dressing table, keeping the door locked, that he may be sure no person has entered his room: he *will next day* find the answer written on it.

The Restored Flowers.

MAKE a bouquet of artificial flowers; the leav be formed of parchment. Dip the roses in the ı ble ink, the jonquils in the yellow, the pinks in t and the leaves in the green ink. They will a white; and you shew them to the company, c that you will restore them to their natural col desiring any person to fix any private mark on pleases, that he may be sure there is no decepti then, unperceived by the company, dip them in vifying liquor, used to make the yellow ink vi scribed in page 24, and drawing them gently out liquor may drop, and the flowers have time t their colours, you present them to the company, see, with surprise, that they each appear in the colours.

Winter changed to Spring.

TAKE a print that represents winter, and co parts which should appear green, with the seco invisible ink, described in page 24; observing, c the usual rules of perspective, by making the n deeper in colour that the others. The other ob be painted in their natural colours. Then put into a frame with a glass, and cover the back wit that is pasted only at its extremities.

When this print is exposed to a moderate fir warm sun, the foliage, which appeared covered w will change to a pleasing green; and if a yellow thrown on the lighter parts before the invisibl drawn over it, this green will be of different When it is exposed to the cold, it will again re first appearance of winter.

The Silver Tree.

DISSOLVE an ounce of fine silver in three o strong aqua fortis, in a glass bottle. When the dissolved, pour the aqua fortis into another gla (a decanter will be best,) with seven or eight c

mercury, to which add a quart of common water; to the whole add your dissolved silver, and let it remain untouched.

In a few days the mercury will appear covered with a number of little branches of a silver colour. This appearance will encrease for a month or two, and will remain after the mercury is entirely dissolved.

Lead Tree.

A more modern invention, and an easier method by far than the above, is the following:

To a piece of zinc fasten a wire, crooked in the form of the worm of a still; let the other end of the wire be thrust through a cork. You then pour spring water into a phial or decanter, to which you add a small quantity of sugar of lead; thrust the zinc into the bottle, and with the cork at the end of the wire fasten it up. In a few days the tree will begin to grow, and produce a most beautiful effect.

To produce beautiful Fire Works in miniature.

Put half a drachm of solid phosphorus into a large pint Florence flask; holding it slanting, that the phosphorus may not break the grass. Pour upon it a gill and a half of water, and place the whole over a tea kettle lamp, or any common tin lamp, filled with spirit of wine. Light the wick, which should be almost half an inch from the flask; and as soon as the water is heated, streams of fire will issue from the water by starts, resembling sky-rockets; some particles will adhere to the sides of the glass, representing stars; and will frequently display brilliant rays. These appearances will continue at times till the water begins to simmer, when immediately a curious aurora borealis begins, and gradually ascends, till it collects to a pointed flame; when it has continued half a minute, blow out the flame of the lamp, and the point that was formed will rush down, forming beautiful illuminated clouds of *fire, rolling* over each other for some time, which,

disappearing, a splendid hemisphere of stars pr itself; after waiting a minute or two, light the lamp and nearly the same phenomenon will be displayed a the beginning. Let the repetition of lighting and bl out the lamp be made for three or four times at lea the stars may be increased. After the third or time of blowing out the lamp, in a few minutes aft internal surface of the flask is dry, many of the sta shoot with great splendour from side to side, and s them will fire off with brilliant rays! these appea will continue several minutes. What remains in th will serve for the same experiment several time without adding any more water. Care should be after the operation is over, to lay the flask and w a cool secure place.

Artificial Rain and Hail.

Make a hollow cylinder of wood; let it be very the sides about eight or ten inches wide, and two o feet in diameter. Divide its insides into five equa by boards of five or six inches wide, and let th between them and the wooden circle, a space of abo sixth of an inch. You are to place these boards obli In this cylinder put four or five pounds of shot th easily pass through the opening. When turned down, the noise of the shot going through the partitions will resemble rain; and if you put large will produce the sound of hail.

Illuminated Writing.

It is well known that if any words are writte wall with solid phosphorus, the writing will appe on fire, but it is necessary to give this caution, le dents should occur:—In using it, let a cup of wa always near you; and do not keep it more than a and a half in your hand, for fear of the warmth o hand should set it on fire. When you have writte *words* with it, put the phosphorus into the cup o

and let it stay a little to cool: then take it out, and write with it again.

A Lamp that will burn Twelve Months without replenishing.

Take a stick of phosphorus, and put it into a large dry phial, not corked, and it will afford a light sufficient to discern any object in a room when held near it. The phials should be kept in a cool place, where there is no great current of air, and it will continue its luminous appearance for more than twelve months.

Curious Transcolourations.

Put half a table-spoonful of syrup of violets, and three table spoonfuls of water into a glass; stir them well together with a stick, and put half the mixture into another glass. If you add a few drops of acid of vitriol into one of the glasses and stir it, it will be changed into a crimson; put a few drops of fixed alkali dissolved into the other glass, and when you stir it, it will change to green. If you drop slowly into the green liquor, from the side of the glass, a few drops of acid of vitriol, you will perceive crimson at the bottom, purple in the middle, and green at the top; and by adding a little fixed alkali dissolved to the other glass, the same colours will appear in different order.

Another.

If you put a tea-spoonful of a liquor composed of copper infused in acid of vitriol, into a glass, and add two or three table-spoonfuls of water to it, there will be no sensible colour produced; but if you add a little volalile alkali to it, and stir it, you will perceive a very beautiful blue colour. Add a little acid of vitriol, the colour will instantly disappear upon stirring it: and by adding a little fixed alkali dissolved, it will return again.

Another.

Put half a tea-spoonful of a liquor composed of infused in acid of vitriol, into half a glass of water; add a few drops of phologisticated alkali, and a beau Prussian blue will appear.

Curious account of the Electric Effects of a Russian Cli

Mr. Æpinus, in a letter to Dr. Guthrie, relates the lowing phenomena, which took place in Russia, w a severe frost had continued for several weeks.

Mr. Æpinus, was sent for to the place to see an unc mon phenomenon. On going into the apartmen Prince Orloff, he found him at the toilet, and that e time his valet drew the comb through his hair, a st crackling noise was heard; and on darkening the r sparks were seen following his comb in great abunda while the Prince himself was so completely electri that strong sparks could be drawn from his hands face; nay, he was even electrified, when he was powdered with a puff.

A few days after, he was a witness to a more stri effect of the electric state of a Russian atmosphere. Grand Duke of Russia sent for him one evening in twilight, and told him, that having briskly drawn a fl cover off a green damask chair in his bed-chambe was astonished at the appearance of a strong bright f that followed; but considering it as an electrical ap ance, he had tried to produce a similar illumination o ferent pieces of furniture, and could then shew h beautiful and surprising experiment. His Highness t himself on his bed, which was covered with a da quilt, laced with gold; and rubbing it with his han all directions, the young prince, who had then reache twelfth year, appeared swimming in fire, as at stroke flames arose all around him, darted to the lace border, ran along it, and up to that of the bed, even to the very top.

While he was shewing this experiment, Prince

came into the room, with a sable muff in his hand, and shewed us, that by only whirling it five or six times round his head in the air, he could electrify himself so strongly, as to send out sparks from all the uncovered parts of his body.

Astonishing Power of Steam.

If you put a small quantity of water in a tea kettle, and place it on the fire, it will disappear in a short time, having escaped in steam. But if its escape is prevented, by stopping up the spout and crevices, it will force its way, by bursting the vessel in which it was confined.

If the steam of boiling water be at liberty, the water never attains more than a certain degree of heat; but if confined in a close vessel, the additional fire not escaping, the power of the steam is increased, it re-acts upon the water, and raises the heat so much higher, that it would keep lead in a melting state; and so penetrating that it would soften the marrow-bone of an ox, in a few minutes.

There is an instrument contrived for the foregoing purposes, called Papin's Digester, from the name of its inventor, and from its digestive powers on substances exposed to its action. It is a very strong vessel, made of copper, fitted with a thick close cover, and fastened down by several strong screws, so as to render it steam-tight in great degrees of heat. To render it safe, while being used, there is a valve on the cover to let out the steam when it is too violent; this valve is kept down by a steelyard, with a weight moveable upon it, to regulate the degrees of the steam within.

The following account of an accident with one of these instruments, will give some idea of the great force of steam:

Mr. Papin (the inventor) having fixed all things right, and included about a pint of water, with two ounces of marrow-bone, he placed the vessel horizontally between the bars of the grate, about half-way into the fire. In three minutes he found it raised to a great heat, an erceiving the heat in a very short time become m

raging, he stepped to a side-table for an iron to take th digester out of the fire, when it suddenly burst with th explosion of a musket. It was heard at a considerab distance, and actually shook the house. The bottom of the vessel that was in the fire gave way; the blast of the expanded water blew all the coals out of the fire into the room, the remainder of the vessel flew across th room, and hitting the leaf of an oak table, an inch thick, broke it all in pieces, and rebounded half th length of the room back again. He could not perceiv the least sign of water, though he looked carefully for it the fire was quite extinguished, and every coal black i an instant.

The following accident was attended with more fat consequences:

A steam-engine was repairing at Chelsea, and as th workmen were endeavouring to discover the defect, th barrel suddenly exploded, and a cloud of steam rushin out at the fracture, struck one of the men who was ne it, and killed him in a moment, like a blast of lightning when his companions endeavoured to take off his clothe the flesh came off with them from the bones.

Account of the wonderful Effects of two immense Burni Glasses.

Mr. de Tschirnhausen constructed a burning gla between three and four feet in diameter, and whose foc was rendered more powerful by a second one. This gla melted tiles, slates, pumice-stone, &c. in a moment, pit and all resins, were melted even under water; the ash of vegetables, wood, and other matters, were converte into glass; indeed it either melted, calcined, or dissipate into smoke, every thing applied to its focus.

Mr. Parker, of Fleet street, made a burning glass, thre feet in diameter; it was formed of flint glass, and wh in its frame, exposed a surface of 2 feet 8½ inches to th solar rays. It had a small glass fitted to it to conver the rays and heighten the effect. The experiments ma by it were more powerful and accurate than those perfor

any other glass. The following is a brief epitome astonishing powers:

ances melted, with their Weight; and Time, in Seconds, which they took in ting.	Weight in Grains.	Time in Seconds.
gold	20	4
silver	20	3
copper	33	20
platina	10	3
ell	16	3
ɔe of bar-iron	10	12
—— cast-iron	10	3
—— steel	10	12
a of wrought-iron	12	2
sh	10	3
;, or terra ponderosa	10	7
paz, or chrysolite	3	45
ɪriental emerald	2	25
'stal pebble	7	6
te agate	10	30
ntal flint	10	30
;h cornelian	10	75
er	10	25
ɪ	10	20
ıet	10	17
te rhomboidal spar	10	60
ites	10	23
en stone	10	80
ımon slate	10	2
estos	10	10
ımon lime-stone	10	55
ıice-stone	10	24
ı	10	7
:anic clay	10	60
ıish moor-stone	10	60

Fulminating Powder.

This powder is made by rubbing together, in a marble mortar, with a wooden pestle, three parts, weight, of nitre, two of mild vegetable alkali, and of flowers of sulphur, till the whole is accurately mix If a drachm of this powder be exposed to a gentle he in an iron ladle, till it melts, it will explode with a no as loud as the report of a cannon.

A more powerful Fulminating Powder.

The most wonderful instance of chemical detonat is formed by the combination of volatile alkali w silver. Gunpowder, or fulminating gold, are not to compared with this invention, and the great dan attending its manufacture prevents us from giving methodical account of its preparation to our read particularly as it can be purchased, properly prepa of the chemists.

The slightest agitation or friction is sufficient to ca its explosion. When it is once obtained, it can no lon be touched with safety. The falling of a few atoms it, from a small height, produces an explosion: a d of water falling on it has the same effect. No attem therefore, can be made to inclose it in a bottle, bu must be let alone in the capsule, wherein, by exaporati it obtains this terrible property. To make this experim with safety, no greater quantity than a grain of sil should be used; the last process of drying should be m in a metallic vessel, and the face of the operator defen by a mask with strong glass eyes.

To make the Phosphorus Match Bottles.

Nothing more is necessary for this purpose, than drop small pieces of dry phosphorus into a comm phial; gently heat it till it melts; and then turn bottle round, that it may adhere to the sides. The pl should be closely corked; and, when used, a comm *brimstone* match is to be introduced, and rubbed aga

the sides of the phial: this inflames the match when it is brought out of the bottle. Though there is no danger in phosphorus, till friction, or fire, is applied, yet persons cannot be too cautious in the use of it, as instances have been known of one of these bottles catching fire in the pocket, and very much endangering the person who carried it; likewise, if carelessly used, small particles are apt to get under the nails, or on the hand; and if, by accident, they are held to the fire, or rubbed together, a flame will presently kindle.

To make a Ring suspend by a Thread, after the Thread has been burned.

Soak a piece of thread in urine, or common salt and water. Tie it to a ring, not larger than a wedding ring. When you apply the flame of a candle to it, it will burn to ashes, but yet sustain the ring.

To form Figures in relief on an Egg.

Design on the shell any figure or ornament you please, with melted tallow, or any other fat oily substance; then immerse the egg in very strong vinegar, and let it remain till the acid has corroded that part of the shell which is not covered with the greasy matter: those parts will then appear in relief, exactly as you have drawn them.

To give a ghastly Appearance to Persons in a Room.

Dissolve salt in an infusion of saffron and spirits of wine. Dip some tow in this solution, and having set fire to it, extinguish all the other lights in the room.

To change Blue to White.

Dissolve copper filings in a phial of volatile akali: when the phial is unstopped, the liquor will be blue; when stopped, it will be white.

Magical Transmutations.

INFUSE a few shavings of logwood in common wat and when the liquor is sufficiently red, pour it into bottle. Then take three drinking glasses, and rince o of them with strong vinegar; throw into the second small quantity of pounded alum, which will not l observed, if the glass has been recently washed, a leave the third without any preparation. If the red quor in the bottle be poured into the first glass, it w appear of a straw colour; if into the second, it will pa gradually from bleuish grey to black, if stirred with key, or any piece of iron, which has been previou dipped in strong vinegar. In the third glass, the r liquor will assume a violet tint.

To make Pomatum with Water and Wax.

WATER and wax are two substances that do not uni together; therefore, to those who witness the followi process, without knowing the cause, it will have t appearance of marvellous. Put into a new glazed earth pot, six ounces of river water and two ounces of whi wax, in which you must previously conceal a strong do of salt of tartar. If the whole be then exposed to considerable degree of heat, it will assume the consisten of pomatum, and may be used as such.

Iron transformed into Copper.

DISSOLVE blue vitriol in water, till the water is w impregnated with it, and immerse into the solution sn plates of iron, or coarse iron filings. These will attacked and dissolved by the acid of the vitriol, while copper naturally contained in the vitriol will be su and deposited in the place of the iron dissolved. If piece of iron be too large for dissolving, it will be completely covered with particles of copper as to res ble that metal itself.

Iron transformed into Silver.

Dissolve mercury in marine acid, and dip a piece of iron into it, or rub the solution over the iron, and it will assume a silver appearance.

It is hardly necessary to say, that these transmutations are only apparent, though to the credulous it would seem that they were actually transformed.

Chemical Illuminations.

Put into a middling sized bottle, with a short wide neck, three ounces of oil or spirit of vitriol, with twelve ounces of common water, and throw into it, at different times, an ounce or two of iron filings. A violent commotion will then take place, and white vapours will arise from the mixture. If a taper be held to the mouth of the bottle, these vapours will inflame, and produce a violent explosion; which may be repeated as long as the vapours continue.

The Philosophical Candle.

Provide a bladder, into the orifice of which is inserted a metal tube, some inches in length, that can be adapted to the neck of a bottle, containing the same mixture as in the last experiment. Having suffered the atmospheric air to be expelled from the bottle, by the elastic vapour produced by the solution, apply the orifice of the bladder to the mouth of the bottle, after carefully squeezing the common air out of it, (which you must not fail to do, or the bladder will violently explode.) The bladder will thus become filled with the inflammable air, which, when forced out against the flame of a candle, by pressing the sides of the bladder, will form a beautiful green flame.

To make the Appearance of a Flash of Lightning wl one enters a Room with a lighted Candle.

DISSOLVE camphor in spirit of wine, and depo vessel containing the solution in a very close room, the spirit of wine must be made to evaporate by and speedy boiling. If any one then enters the with a lighted candle, the air will inflame, wh combustion will be so sudden, and of so short a du as to occasion no danger.

To melt Iron in a Moment and make it run into dr

BRING a bar of iron to a white heat, and then a it a roll of sulphur. The iron will immediately me run into drops.

This experiment should be performed over a b water, in which the drops that fall down will be que These drops will be found reduced into a sort of ca

Never-yielding Cement.

CALCINE oyster shells, pound them, sift them tl a silk sieve, and grind them on porphyry till th reduced to the finest powder. Then take the wl several eggs, according to the quantity of the po and having mixed them with the powder, form the into a kind of paste. With this paste join the pi china or glass, and press them together for se eight minutes. This cement will stand both he water, and will never give way, even if the article s by accident, fall to the ground.

To remove Stains and Blemishes from Prints.

PASTE a piece of paper to a very smooth clear tabl the boiling water, used in the operation, may not a a colour which might lessen its success. Spread o print you wish to clean upon the table, and spri *with boiling* water; taking care to moisten it throu

:y carefully applyiug a very fine sponge. After you repeated this process five or six times, you will re the stains or spots extend themselves; but this is proof that the dirt begins to be dissolved.
er this preparation, lay the print smoothly and lly into a copper or wooden vessel, larger than the of the print. Then cover it with a boiling ley of , taking care to keep it hot as long as possible. the whole is cooled, strain off the liquor, take out rint with care, spread it on stretched cord, and half dry, press it between leaves of white paper to nt wrinkles.
this process, spots and stains of any kind will be ually removed.

fill a glass with Water that it cannot be removed without spilling the whole.

is is a mere trick; but may afford some amusement. ffer to bet any person that you will so fill a glass water that he shall not move it off the table without g the whole contents. You then fill the glass, and a piece of paper or thin card over the top, you rously turn the glass upside down on the table, and drawing away the paper, you leave the water in the with its foot upwards. It will therefore be impos- o remove the glass from the table without spilling drop.

Figures, one of which blows out and the other re-lights a Candle.

KE two figures, of any shape or materials you please, in the mouth of one a small tube, at the end of is a piece of phosphorus, and in the mouth of the a tube containing at the end a few grains of gun- er; taking care that each be retained in the tube be e of paper. If the second figure be applied to the of a taper, it will extinguish it; and the first will it again.

A Vessel that will let Water out at the bottom, as soon the Mouth is uncorked.

PROVIDE a vessel of tin-plate, two or three inche diameter, and five or six inches in height, having a mo about three inches in width; and in the bottom seve small holes, just large enough to admit a small nee Plunge it in water with its mouth open, and when f while it remains in the water, stop it very closely. can play a trick with a person, by desiring him to unc it; if he places it on his knee for that purpose, the ment it is uncorked the water will run through at the b tom, and make him completely wet.

A Powder which catches Fire when exposed to the Air

PUT three ounces of rock alum, and one ounce of ho or sugar, into a new earthen dish, glazed, and whic capable of standing a strong heat; keep the mixture o the fire, stirring it continually till it becomes very dry hard: then remove it from the fire, and pound it coarse powder. Put this powder into a long necked bot leaving part of the vessel empty; and having placed i a crucible, fill up the crucible with fire sand, and surro it with burning coals. When the bottle has been kept red heat for about seven or eight minutes, and no m vapour issues from it, remove it from the fire, then sto with a piece of cork; and having suffered it to cool, serve the mixture in small bottles well closed.

If you unclose one of these bottles, and let fall a grains of this powder on a bit of paper, or any other dry substance, it will first become blue, then brown, will at last burn the paper or other dry substance on wh it has fallen.

Fulminating Gold.

PUT into a small long necked bottle resting on a li sand, one part of fine gold filings, and three parts of a regia, (nitro-muriatic acid.) When the gold is dissolv pour the solution into a glass, and add five or six ti

ty of water. Then take spirit of sal ammoniac
rtar, and pour it drop by drop into the solution,
old is entirely precipitated to the bottom of the
:cant the liquor that swims at the top, by inclin-
ıss; and having washed it several times in warm
· it at a moderate heat, placing it on paper ca-
bsorbing all the moisture.
n of this powder, put into a spoon (it should be
.e) be exposed to the flame of a candle, it will
ith a very loud report.

Piece of Money in a Walnut-Shell, without injuring the Shell.

ıy thin coin, and put it into half a walnut-
:e the shell on a little sand, to keep it steady.
he shell, with a mixture made of three parts of
ɔunded nitre, one part of flowers of sulphur, and
·-dust well sifted. If you then set light to the
·ou will find, when it is melted, that the metal
ɜ melted in the bottom of the shell, in form of a
ıich will become hard when the burning matter
. consumed; the shell will have sustained very
/.

A Liquor that shines in the Dark.

bit of phosphorus, about the size of a pea;
ınto small parts, which you are to put into a
full of very pure water, and boil it in a small
ssel, over a very moderate fire. Have in readi-
; narrow bottle, with a well fitted glass stopper,
·se it, with its mouth open, into boiling water.
it out, empty the water, and immediately pour
ture in a boiling state; then put in the stopper,
it with mastich, to prevent the entrance of the
r.
ter will shine in the dark for several months,
out being touched; and if it be shaken in dry
ther, brilliant flashes will be seen to rise thou
: of the water.

Luminous Liquor.

Put a little phosphorus with essence of cloves, into bottle, which must be kept closely stopped. Every tim the bottle is unclosed, the liquor will appear lumino This experiment must be performed in the dark.

The changeable Rose.

Take a common full-blown rose, and having throw a little sulphur finely pounded into chaffing-dish wi coals, expose the rose to the vapour. By this process th rose will become whitish; but if it be afterwards he some time in water, it will resume its former colour.

Golden Ink.

Take some white gum arabic, reduce it to an impa pable powder, in a brass mortar, dissolve it in stro brandy, and add a little common water to render it mo liquid. Provide some gold in a shell, which must detached, in order to reduce it to a powder. When th is done, moisten with the gummy solution, and stir th whole with a small hair brush, or your finger; then lea it for a night, that the gold may be better dissolve If the composition becomes dry during the night, dilu it with more gum water, in which a little saffron has be infused; but take care that the gold solution be sufficient liquid to flow freely in a pen. When the writing is d polish it with a dry tooth.

Another Way.

Reduce gum ammoniac into powder, and dissolve it gum arabic water, to which a little garlic juice has be added. This water will not dissolve the ammoniac so as form a transparent liquid; for the result will be a mil liquor. With this liquor form your letters or ornamen on paper or vellum, with a pen or fine camel's-h brush; then let them dry, and afterwards breathe them some time, till they become moist; then appl

few bits of leaf-gold to the letters, which you press down gently with cotton wool. When the whole is dry, brush off the superfluous gold with a large camel's-hair brush, and to make it more brilliant, burnish with a dog's tooth.

White Ink for writing on Black Paper.

Having carefully washed some egg-shells, remove the internal skin, and grind them on a piece of porphyry: Then put the powder into a small vessel of pure water, and when it has settled at the bottom, draw off the water, and dry the powder in the sun. This powder must be preserved in a bottle; when you want to use it, put a small quantity of gum ammoniac into distilled vinegar, and leave it to dissolve during the night. Next morning the solution will appear exceedingly white; and if you then strain it through a piece of linen cloth, and add to it the powder of egg-shells, in sufficient quantity, you will obtain a very white ink.

To construct Paper Balloons.

Take several sheets of silk paper; cut them in the shape of a spindle; or, to speak more familiarly, like the coverings of the sections of an orange; join these pieces together, into one spherical or globular body, and border the aperture with a ribbon, leaving the ends, that you may suspend them from the following lamp:

Construct a small basket of very fine wire, if the balloon is small, and suspend it from the aperture, so that the smoke from the flame of a few leaves of paper, wrapped together, and dipped in oil, may heat the inside of it. Before you light this paper, suspend the balloon in such a manner, that it may, in a great measure, be exhausted of air, and, as soon as it has been dilated, let it go, together with the wire basket, which will serve as ballast.

Water-Gilding upon Silver.

Take copper-flakes, on which pour strong vinegar; add alum and salt in equal quantities; set them on a fire, and when the vinegar is boiled, till it becomes one-fourth part of its original quantity, throw into it the metal you design to gild, and it will assume a copper colour. Continue boiling it, and it will change into a fine gold colour.

A Water, which gives Silver a Gold Colour.

Take sulphur and nitre, of each an equal quantity; grind them together very fine, and put them into an unglazed vessel; cover and lute it well; then set it over a slow fire for 24 hours, put what remains into a strong crucible and let it dissolve; put it into a phial, and whatever silver you anoint with it, will have a gold colour.

To make an old Gold Chain appear as new.

Dissolve sal ammoniac in urine, boil the chain in it, and it will have a fine gold colour.

To give Silver the colour of Gold.

Dissolve in common aqua fortis as much silver as you please. To eight ounces of silver, take four ounces of hepatic aloes, six ounces of turmeric, and two ounces of prepared tutty, that has been several times quenched in urine. Put these to the solution of the silver; they will dissolve, but rise up in the glass like a sponge; this glass must therefore be large to prevent running over. Then draw it off, and you will have ten ounces of silver as yellow as gold.

A Water, to give any Metal a Gold Colour.

Take fine sulphur and pulverize it; then boil some *stale spring* water; pour it hot upon the powder, and stir

it well together; boil it, and pour into an ounce of dragon's blood. After it is well boiled, take it off, and filter it through a fine cloth; pour this water into a matrass (a chemical vessel,) after you have put in what you design to colour; close it well and boil it, and the metal will be a fine gold colour.

Another Way.

Take hepatic aloes, and nitre, and Roman vitriol, of each equal quantities; and distil them with water, in an elembic, till all the spirits are extracted; it will at last yield a yellowish water, which will tinge any sort of metal of a gold colour.

To give Silver-Plate a Lustre.

Dissolve alum in a strong ley; scum it carefully; then mix it up with soap, and wash your silver utensils with it, using a linen rag.

The Fiery Fountain.

If twenty grains of phosphorus, cut very small, and mixed with forty grains of powder of zinc, be put into four drachms of water; and two drachms of concentrated sulphuric acid, be added thereto, bubbles of inflamed phosphorated hydrogen gas will quickly cover the whole surface of the fluid in succession, forming a real fountain of fire.

To take Impressions of Coins, Medals, &c.

Cut fish-glue, or isinglass, into small pieces, immerse it n clear water, and set it on a slow fire; when gradually lissolved, let it boil slowly, stirring it with a wooden poon, and taking off the scum. The liquor being sufciently adhessive, take it off the fire, let it cool a little, nd then pour it on the medal or coin you wish to copy, aving first rubbed the coin over with oil. Let the omposition lay about the thickness of a crown-piece

on the medal. Then set it in a moderate air, r too hot nor too cold, and let it cool and dry. W is dry, it will loosen itself; you will find the impı correct, and the finest strokes expressed with the gı accuracy.

You may give a more pleasing effect to the compc by mixing any colour with it, red, yellow, blue, gree and if you add a little parchment size to it, it will it harder and better. This size is made by gently si ing the cuttings of clear white parchment in a ı with a little water, till it becomes adhesive.

To tell a Person any number he may privately fix

When the person has fixed on a number, bid him ı it and add four to that doubling; then multiply the by 5; to the product let him add 12, and multip amount by 10. From the total of all this, let him ı 320, and tell you the remainder; from which, if y off the two last figures, the number that remains what he fixed on. For instance,

Suppose the number chosen is . .	
Which doubled	
Add 4 to it, and it will make . . .	
Multiply 18 by 5, gives	
To which add 12, is	
Multiply that by 10, makes . . .	
From which deducting 320, the remainder is	
And by striking off the two cyphers, it becomes the number thought on . .	

To tell any number a Person has fixed on, without him any Questions.

You tell the person to choose any number from 1 he is to add 21 to that number, and triple the a Then

1. He is to take the half of that triple, and trip *half.*

2. To take the half of the last triple, and triple that half.

3. To take the half of the last triple.

4. To take the half of that half.

Thus, it will be seen there are four cases where the half is to be taken : the three first are denoted by one of the eight following Latin words, each word being composed of three syllables, and those that contain the letter I, refer to those cases where the half cannot be taken without a fraction; therefore, in those cases, the person who makes the deduction is to add 1 to the number divided. The fourth case shews which of the two numbers annexed to every word has been chosen; for if the fourth half can be taken without adding 1, the number chosen is in the first column; but if not, it is in the second column.

The words.	*The numbers they denote.*	
Mi-se-ris	8	0
Ob-tin-git	1	9
Ni-mi-um	2	10
No-ta-ri	3	11
In-fer-nos	4	12
Or-di-nes	13	5
Ti-mi-di	6	14
Te-ne-ant	15	7

For example :

Suppose the number chosen is . . .	9
To which is to be added	1
	10
The triple of that number is . . .	30
The half of which is	15
The triple of that half must be . .	45
And the half of that*	23
The triple of that half	69
The half of that*	35
And the half of that half* . . .	18

* At all these stages, 1 must be added, to take the half without a fraction.

While the person is performing the operation, remark, that at the second and third stages he is obl to add 1; and, consequently, that the word *ob-tin* in the second and third syllables of which is an *i*, den that the number must be either 1 or 9; and, by obs ing that he cannot take the last half without addin you know that it must be the number in the sec column. If he makes no addition at any one of four stages, the number he chose must be 15, as th the only number that has not a fraction at either of divisions.

The Lamp Chronometer.

Refer to Fig. 4. It represents a chamber-lamp, consisting of a cylindrical vessel made of tin, in shape of a candle, and is to be filled with oil. This ve should be about three inches high and one inch diamet placed in a stand, B. The whole apparatus, of lamp stand, can be purchased ready made, at any tin-shop London. To the stand B, is fixed the handle C, whi supports the frame D, about 12 inches high, and f inches wide. This frame is to be covered with oiled pap and divided into 12 equal parts by horizontal lines, at t end of which are written the numbers for the hours, fr 1 to 12, and between the horizontal lines and diagon divided into halves, quarters, &c. On the handle, C, a close to the glass, is fixed the style or hand, E.

Now, as the distance of the style from the flame of t lamp is only half an inch, then, if the distance of the fla from the style be six inches, while the float that con the light descends by the decrease of the oil, one i the shadow of the style on the frame will ascend 12 inc being its whole length, and show, by its progress the regular increase of the hours, with their seve divisions.

You must be careful always to burn the same oil, w must be the best; and the wick must never vary in s if these precautions are not attended to, the dial n can be accurate.

The Phial of the Four Elements.

a phial, six or seven inches long, and about
arters of an inch in diameter. In this phial put,
ss coarsely powdered; secondly, oil of tartar per
n; thirdly, tincture of salt of tartar; and lastly,
rock oil.
glass and the various liquors being of different
i, if you shake the phial, and then let it rest a
nents, the three liquors will entirely separate,
h assume its place; thus forming no indifferent
ance of the four elements, earth, fire, water, and
powdered glass (which should be of some dark
representing the earth; the oil of tartar, water;
ure, air; and the rock oil, fire.

The Magic Bottle.

a small bottle, the neck of which is not more
e sixth of an inch in diameter. With a funnel,
bottle quite full of red wine, and place it in a
sel, similar to a shew glass, whose height exceeds
the bottle about two inches; fill this vessel with
The wine will shortly come out of the bottle,
in the form of a small column to the surface
ater; while, at the same time, the water entering
le, will supply the place of the wine. The reason
s, that as water is specifically heavier than wine,
hold the lower place, while the other rises to the

fect equally pleasing will be produced, if the bot-
lled with water, and the vessel with wine.

The Globular Fountain.

a hollow globe, of copper or lead, and of a size
l to the quantity of water that comes from a pipe
ber mentioned) to which it is to be fixed, and
may be fastened to any kind of pump; provided
constructed, that the water shall have no other
f escape than through the pipe. Pierce a number

of small holes through the globe, that all tend
its centre, and annex it to the pipe that communica
the pump. The water that comes from the pump,
with violence into the globe, will be forced ou
holes, and form a very pleasing sphere of water.

The Hydraulic Dancer.

PROCURE a little figure made of cork, which y
dress as your fancy dictates. In this figure place
hollow cone, made of thin leaf brass.

When the figure is placed on a jet d'eau tha
in a perpendicular direction, it will be suspended
top of the water, and perform a great variety of a
motions.

If a hollow ball, of very thin copper, of an in
meter, be placed on a similar jet, it will rema
pended, turning round, and spreading the wa
about it.

*A Person having put a Ring on one of his I
to name the Person, the Hand, the Finger, a
Joint on which it is placed.*

LET a third person double the number of the
in which he stands who has the ring, and add 5
number; then multiply that sum by 5, and to the p
add 10. Let him next add 1 to the last number,
ring be on the right hand, and 2 if on the lef
multiply the whole by 10: to the product of this h
add the number of the finger, (counting the thumb
first finger) and multiply the whole again by 10
him then add the number of the joint, and lastly,
whole join 35.

He is then to tell you the amount of the whole
which you are to subtract 3535, and the remaind
consist of four figures; the first of which will e
the rank in which the person stands, the seco
hand, (number 1 signifying the right, and 2 th

ıe third number the finger, and the fourth the joint.—
or example:

Suppose the person who stands the third in order has
ıt the ring upon the second joint of the thumb of his left
and; then,

The double of the rank of the third person is	6
To which add	5
	11
Multiply the sum by	5
	55
To which add	10
And the number of the left hand . . .	2
	67
Which being multiplied by	10
	670
To which add the number of the thumb . .	1
	671
And multiply again by	10
	6710
Then add the number of the joint . .	2
And lastly, the number	35
	6747
From which deducting	3535
The remainder is	3212

ıf which, as we have said, the 3 denotes the third person,
ıe 2 the left hand, the 1 the thumb, and the last 2
ıe second joint.

The Water Sun.

Provide two portions of a hollow sphere, that are
v shallow; join them together in such a manner that

the hollow between them be very narrow. Fix th vertically to a pipe from whence a jet proceeds. Bor number of small holes all round that part where the t pieces are joined together. The water rushing throu the holes will form a very pleasing water sun, or star.

Th Magical Cascade.

Procure a tin vessel, shaped like fig. 5, about f inches high and four in diameter, with a cover C clos at top. To the bottom of this vessel, let the pipe D be soldered. This pipe is to be ten inches long, and h an inch in diameter, open at each end, and the upp end must be above the water in the vessel. To the bott also fix five or six small tubes, F, about one eighth of inch in diameter. By these pipes, the water in the ves is to run slowly out.

Place this machine in a tin basin, G H, with a hole the middle, about a quarter of an inch in diameter. F to the tube, D E, any sort of ornament that will keep t machine firm on the basin, observing, that these suppo are sufficiently long to leave about a quarter of an in between the end of the tube and the orifice in the basi and let there be a vessel under the basin to catch the wat that runs out.

As the small pipes discharge more water into t basin than can run out of the central orifice, the wat will rise in the basin above the lower end of the pipe, a prevent the air from getting into the vessel, by whi the water will cease to flow from the small pipes. But the water continues to flow from the basin, the air w have liberty again to enter the vessel by the tube, a the water will again flow from the small pipes, and alt nately stop and flow, while any water remains in t vessel.

As you can guess when the pipes will flow, and wh they will stop; you may so manage it, that they w appear to act by word of command.

The illuminated Fountain, that plays when the Candles are lighted, and stops when they are extinguished.

PROVIDE two cylindrical vessels, A B and C D, (see Fig. 6.) Connect them by four tubes open at each end, as H I, &c. so that the air may descend out of the higher into the lower vessel. To these tubes fix candlesticks, and to the hollow cover, E F, of the lower vessel, fit a tube, K, reaching almost to the bottom of the vessel. At G let there be an aperture with a screw, whereby water may be poured into C D, which, when filled, must be closed by the screw.

When the candles are lighted, the air in the upper cover and contiguous pipes will be thereby rarified, and the jet from the small tube K, will begin to play: as the air becomes more rarified, the force of the jet will increase, and it will continue to play till the water in the lower vessel is exhausted. As the motion of the jet is caused by the heat of the candles, when they are extinguished the fountain will stop.

A Fountain which acts by the Heat of the Sun.

[Refer to the Frontispiece, Fig. 7.]

G N S is a thin hollow globe of copper, eighteen inches diameter, supported by a small inverted basin, placed on a stand with four legs, A B C D, which have between them, at the bottom, a basin of two feet diameter. Through the leg C passes a concealed pipe, which comes from G, the bottom of the inside of the globe. This pipe goes by H V, and joins the upright pipe *u* I, to make a jet as I. The short pipe *u* I, which goes to the bottom, has a valve at *u*, under the horizontal pipe H V, and another valve at V, above that horizontol pipe, under the cock at K. The use of this cock is to keep the fountain from playing in the day, if you think proper. The north pole, N, of the globe has a screw that opens a hole, whereby water is poured into the globe.

The machine being thus prepared, and the globe *half filled with* water, put it in an open place, when *the heat of* the sun, rarifying the air as it heats the

copper, the air will press strongly against the which coming down the pipe, will lift up the valve and shut the valve at *u*. The cock being opene water will spout out at I, and continue to play while, if the sun shines.

Inflammable Phosphorus.

Take the meal or flour of any vegetable, put it i iron pan over a moderate fire, and keep it stirring an iron spoon till it changes to a black powder; t part of this add four parts of raw alum. Make the into a fine powder, put it again into the iron pan keep stirring it till it almost catches fire, to preve forming into lumps, as it is apt to do when the melts, in which case it must be broken again, stirred and accurately mixed with the flour, till it emit no fumes, and the whole appears a fine dry black powd

Put this powder in a clean dry phial with a n neck, filling it to about one-third of the top. Ther the mouth of the phial with loose paper, so as to l air pass freely through it, and leave room for fum come through the neck. Place the phial in a cru encompassed on all sides with sand, so that it ma touch any part of the crucible, but a considerable every where left between. The phial must be co up with sand, leaving only a small part bare, by you can discern whether the powder is ignited. I state, the crucible is to be surrounded with coals, ki slowly till it is well heated on all sides, and the fire is to be raised, till the crucible and every thi it is red hot; keep it in this state an hour; after the fire still burning as fiercely, close up the orifi the phial with wax, to exclude the air. Leave it to and you will find in it a black dusty coal formed o flour and alum.

Shake a small quantity of this out of the phial int cool air, and it will immediately take fire, but wil burn any thing. Keep the bottle dry, as even the air spoil it effectually.

The Magical Mirrors.

MAKE two holes in the wainscot of a room, each a foot high and ten inches wide, and about a foot distant from each other. Let these apertures be about the height of a man's head, and in each of them place a transparent glass in a frame, like a common mirror.

Behind the partition, and directly facing each aperture, place two mirrors, inclosed in the wainscot, in an angle of forty-five degrees.* These mirrors are each to be eighteen inches square: and all the space between them must be enclosed with pasteboard painted black, and well closed, that no light can enter; let there be also two curtains to cover them, which you may draw aside at pleasure.

When a person looks into one of these fictitious mirrors, instead of seeing his own face, he will see the object that is in front of the other; thus if two persons stand at the same time before these mirrors, instead of each seeing himself, they will reciprocally see each other.

There should be a sconce with a lighted candle, placed on each side of the two glasses in the wainscot, to enlighten the faces of the persons who look in them, or the experiment will not have so remarkable an effect.

To cause a brilliant Explosion under Water.

DROP a piece of phosphorus, the size of a pea, into a tumbler of hot water; and, from a bladder furnished with a stop cock, force a stream of oxygen directly upon it. This will afford a most brilliant combustion under water.

Fulminating Mercury.

DISSOLVE 100 grains of mercury by heat, in an ounce and a half nitric acid. This solution being poured cold upon two measured ounces of alcohol, previously

* That is, half-way between a line drawn perpendicularly to the ground and its surface.

introduced into any convenient glass vessel, a m heat is to be applied, till effervescence is excited. . fume then begins to appear on the surface of the and the powder will be gradually precipitated w action ceases. The precipitate is to be imm collected on a filtre, well washed with distilled wa cautiously dried in a heat not exceeding that of : bath. Washing the powder immediately is n because it is liable to the re-action of the nitric aci while any of the acid adheres to it; it is very subjec action of light. From 100 grains of mercury, abou the powder are obtained.

This powder, when struck on an anvil with a h explodes with a sharp stunning noise, and with su as to indent both hammer and anvil. Three or fou are sufficient for one experiment.

The Iron Tree.

Dissolve iron filings in aqua fortis, moderate centrated, till the acid is saturated; then ad gradually, a solution of fixed alkali (commonly call tartar per deliquum.) A strong effervescence wil and the iron, instead of falling to the bottom of the will afterwards rise so as to cover the sides, fo multitude of ramifications heaped one upon th which will sometimes pass over the edge of the ves extend themselves on the outside, with all the app of a plant.

To make any Number divisible by Nine, by addin gure to it.

If (for example) the number named be 72,857, the person who names it to place the number 7 b any two figures of that sum, and it will be divisibl for if any number be multiplied by 9, the sum figures of the product will be either 9, or a numb sible by 9.

Arithmetical Magical Squares.

An arithmetical magical square consists of numbers so disposed in parallel and equal lines, that the sum of each, taken any way of the square, amounts to the same.

A Natural Square.

A			G		B
	1	2	3	4	5
	6	7	8	9	10
E	11	12	13	14	15
	16	17	18	19	20
	21	12	23	24	25
C			H		D

A Magical Square.

A					B
	11	24	7	20	3
	4	12	25	8	16
F	17	5	13	21	9
	10	18	1	14	22
	23	6	19	2	15
C					D

Any five of these sums taken in a right line make 65. You will observe that five numbers in the diagonals A to D, and B to C, of the magical square answer to the ranks E to F, and G to H, in the natural square, and that 13 is the central number of both squares.

To form a magical square, first transpose the two ranks in the natural square to the diagonals of the magical square; then place the number 1 under the central number 13, and the number 2 in the next diagonal downward. The number 3 should be placed in the same diagonal line; but as there is no room in the square, you are to place it in that part it would occupy if another square were placed under this. For the same reason, the number 4, by following the diagonal direction, falling out of the square, it is to be put into the part it would hold in another square, placed by the side of this. You then proceed to numbers 5 and 6, still descending; but as the place 6 should hold is already filled, you then go back to the diagonal, and consequently place the 6 in the second case under the 5, so that there may remain an empty space between the two numbers. The same rule is to be observed, whenever you find a space already filled.

You proceed in this manner to fill up the empty cas the angle where the 15 is placed; and as there is no s for the 16 in the same diagonal, descending, you : place it in the part it would hold in another square, continue the same plan till all the spaces are filled. method will serve equally for all sorts of arithmetical gressions composed of odd numbers; even numbers b too complicated to afford any amusement.

To find the difference between two numbers, the greate which is unknown.

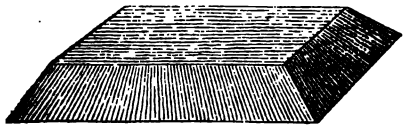
TAKE as many nines as there are figures in the sma number, and subtract the sum from the number of ni Let another person add that difference to the lar number, and taking away that first figure of the amo add it to the last figure, and that sum will be the di ence of the two numbers.

For example, Robert, who is 22, tells George, wh older, that he can discover the difference of their ag he therefore privately deducts 22 from 99, and the ference, which is 77, he tells George to add to his and to take away the first figure from the amount, and it to that last figure, and the last sum will be the differe of their ages. Thus the difference between

Robert's age and 99, is - - - - - -	77
To which George adding his age - -	35
The sum - - -	112
	12
	1
Then by taking away the first figure, 1, and adding it to the last figure 2, the sum is - - - - - - - -	13
Which added to Robert's age - - -	22
Gives George's age, which is - - -	35

The Boundless Prospect.

Take a square box, about six inches long and twelve **igh, or of** any other proportionate dimensions. Cover **e inside** with four flat pieces of looking glass placed **erpendicular** to the bottom of the box. Place at the **ottom any** objects you please, as a piece of fortification, **castle, tents,** soldiers, &c. On the top place a frame of **lass shaped** like the bottom of a pyramid; thus:



nd so formed as to fit on the box like a cover. The four **des of this** cover are to be composed of ground glass or **overed** inside with gauze, so that the light may enter, **nd yet the** inside be invisible, except at the top, which **ust be** covered with transparent glass; when you look **hrough this** glass, the inside will present a pleasing **rospect of** a boundless extent; and if managed with care, **ill afford** a deal of amusement.

To set fire to a combustible Body by Reflection.

Place two concave mirrors at about twelve feet dis**nce from** each other, and let the axis of each be in the **me line.** In the focus of one of them place a live coal, **d in** the focus of the other some gunpowder. With a **ir of strong** bellows keep blowing the coal, and notwith**anding** the distance between them, the powder will **esently** take fire.

The mirror may be either made of glass, metal or **steboard** gilt.

To find the Number of Changes that may be r
Twelve Bells.

MULTIPLY the numbers from 1 to 12 continual
each other, as follow; and the last product will gi
number required.

```
          1
          2
          —
          2
          3
          —
          6
          4
          —
         24
          5
        ———
        120
          6
        ———
        720
          7
        ———
      5,040
          8
      ———
     40,320
          9
     ———
    362,880
         10
   ———————
  3,628,800
         11
 ———————
 39,916,800
         12
 ———————
479,001,600
```

To find how many Square Yards it would require to write all the Changes of the Twenty-four Letters of the Alphabet, written so small that each Letter should not occupy more than the hundredth part of a square Inch.

By adopting the plan of the preceding article the changes of the twenty-four letters will be found to be

62,044,840,173,323,943,936,000

Now the inches in a square yard being 1,296, that number multiplied by 100 gives 129,600, which is the number of letters each square yard will contain, therefore if we divide the above row of figures, (the number of changes) by 129,600, the quotient, which is 478,741,050,720,092,160, will be the number of yards required, to contain the above mentioned number of changes. But as all the 24 letters are contained in every permutation, it will require a space 24 times as large, *viz.*

11,849,785,217,282,211,840.

Now as the surface of the whole globe only contains 617,197,435,008,000 square yards, it would require a surface 18,620 times as large as the earth to contain them.

The Enchanted Bottle.

Fill a glass bottle with water to the beginning of the neck; leave the neck empty, and cork it. Suspend this bottle opposite a concave mirror, and beyond its focus, that it may appear reversed. Place yourself still further distant from the bottle; and instead of the water appearing as it really is, at the bottom of the bottle, the bottom will be empty, and the water seen at the top.

If the bottle be suspended with the neck downwards, it will be reflected in its natural position, and the water at the bottom, although, in reality, it is inverted, and fills the neck, leaving the bottom vacant. While the bottle is in this position, uncork it, and let the water run gradually out; it will appear, that while the real bottle is emptying, the reflected one is filling. Care must be taken that the bottle is not more than half or three parts full, and that no

other liquid is used but water, as in either of these the illusion ceases.

The Solar Magic Lantern.

MAKE a box, a foot high, eighteen inches wid about three inches deep. Two of the opposite si this box must be quite open, and in each of the sides let there be a groove wide enough to admit paper or pasteboard. You fasten the box against dow, on which the sun's rays fall direct. The the window should be closed up that no light may

Next provide several sheets of stiff paper, black one side. On these papers cut out such figures a fancy may dictate; place them alternately in the g of the box, with their blacked sides towards you look at them through a large and clear glass prism if the light be strong, they will appear painted wit most lively colours. If you cut on one of these p the form of a rainbow, about three-quarters of an wide, you will have a very good representation natural one.

For greater convenience, the prism may be placed stand on the table, made to turn round on an axis.

The Artificial Rainbow.

OPPOSITE a window into which the sun shines d suspend a glass globe, filled with clean water, by me a string that runs over a pulley, so that the sun's rays fall on it. Then drawing the globe gradually up, you observe, when it comes to a certain height, and by pl yourself in a proper situation, a purple colour in the g and by drawing it up gradually higher, the other pris colours, blue, green, yellow, and red, will success appear; after which, the colours will disappear, til globe is raised to about fifty degrees, when they will s appear, but in an inverted order, the red appearing and the blue or violet last; on raising the globe a they will totally vanish.

The Æolipiles.

The æolipiles is a small hollow globe of brass, or other metal, in which a slender neck or pipe is inserted. This ball, when made red hot, is cast into a vessel of water, which will rush into its cavity, then almost void of air. The ball being then set on the fire, the water, by the rarefaction of the internal air, will be forced out in steam by fits, with great violence, and with a strange noise.

If to the necks of two or more of these balls, there be fitted those calls that are used by fowlers and hunters, and the balls placed on the fire, the steam rushing from them will make such a horrible noise, that it will astonish any person who is ignorant of the contrivance.

The Talking Busts.

Procure two busts of Plaster of Paris, place them on pedestals, on the opposite sides of a room. Let a thin tube, of an inch diameter, pass from the ear of one head through the pedestal, under the floor, and go up to the mouth of the other; taking care that the end of the tube that is next the ear of the one head, should be considerably larger than that end which comes to the mouth of the other.

Now when a person speaks quite low into the ear of one bust, the sound is reverberated through the length of the tube, and will be distinctly heard by any one placing his ear to the mouth of the other. It is not necessary that the tube should come to the lips of the bust. If there be two tubes, one going to the ear, and the other to the mouth of each head, two persons may converse together, by whispers, without the knowledge of any person who may stand in the middle of the room.

The inanimate Oracle.

Place a bust on a pedestal in the corner of a room, and let there be two tubes, as in the preceding article,

one to go from the mouth, and the other from th
through the pedestal and the floor to an under apartn
there may be also wires, that go from the under
and the eyes of the bust, by which they may be
moved.

A person being placed in the room underneath,
applying his ear to one of the tubes at a signal given,
hear any question asked, and can immediately repl
applying his mouth to the tube which communicate
low, at the same time moving the eyes by the wir
accompany his speech.

The Solar Concerto.

In a large case, similar to what is used for dials,
spring clocks, the front of which, or at least the l
part, must be of glass, covered on the inside with g
place a barrel organ, which when wound up is preve
from playing by a catch that takes a toothed whe
the end of the barrel. To one end of this catch
a wire, at the end of which is a flat circle of cork, o
same dimensions with the inside of a glass tube, in w
it is to rise and fall. This tube must communicate w
reservoir that goes across the front part of the botto
the case, which is to be filled with spirits, such as is
in thermometers.

This case being placed in the sun, the spirits wi
rarefied by the heat, and rising in the tube, will lif
the catch or trigger, and set the organ in play; which
continue as long as it is kept in the sun; for the s
cannot run out of the tube, that part of the catch to w
the circle is fixed being prevented from rising beyo
certain point, by a check placed over it. Care mus
taken to remove the machine out of the sun before
organ runs down, that its stopping may be evid
effected by the cold.

In winter it will perform when placed before the fi

CURIOUS EXPERIMENTS WITH THE MAGIC LANTERN.

The construction of this amusing optical machine is so well known, that to describe it would be superfluous; particularly as it can be now purchased at a very reasonable expense, at any of the opticians'; but as many persons who have a taste for drawing might not be pleased with many designs to be had at the shops, or might wish to indulge their fancy in a variety of objects, which to purchase would become expensive, we here present our readers, in the first place, with the method of drawing them, which will be succeeded by a plain description of some very diverting experiments.

Of Painting the Glasses.

You first draw on a paper, the size of the glass, the subject you mean to paint; fasten this at each end of the glass with paste, or any other cement, to prevent it from slipping. Then with some very black paint mixed with varnish, draw with a fine camel's hair pencil, very lightly, the outlines sketched on the paper, which, of course, are reflected through the glass. Some persons affirm that these outlines can be more readily traced with japan writing ink, and a common pen with a fine nib; but this, even if it succeeds in making a delicate black outline, is likely to be effaced by damp or wet.

It would add to the natural resemblance, if the outlines were drawn with a strong tint of each of the natural colours of the object: but in this respect you may please your own fancy. When the outlines are dry, colour and shade your figures; but observe, to temper your colours with strong white varnish. A pleasing effect will be produced, if you leave strong lights in some part of the drapery, &c. without any colours. The best colours for this purpose are transparent ones; opaque or mineral colours will not do. The following are in most repute.

For Pink and crimson . .	Lake or carmine.
Blue	Prussian blue.
Green	Calcined verdigris, or distilled ditto
Yellow	Gumboge.

To represent a Storm at Sea.

Provide two strips of glass, whose frames are tl enough to admit both strips freely into the grove of t lantern. On one of these glasses paint the appearance sea from a smooth calm to a violent storm, (see Fig. Let these representations run gradually into each oth as in the figure; and you will of course observe that t more natural and picturesque the painting is, the mo natural and pleasing will be the reflection.

On the other glass, (Fig. 9,) paint various vessels on t ocean observing to let that end where the storm is, appe in a state of violent commotion, and the vessels as if ra ed on the waves in an unsettled position, with hea clouds about them.

You then pass the glasses slowly through the groo and when you come to that part where the storm supposed to begin, move them gently up and dow which will give the appearance of the sea and vess being agitated; increase the motion till they come to t height of the storm. You will thus have a very natu representation of the sea and ships in a calm and stor and as you gradually draw the glasses back, the temp will subside, the sky appear clear, and the vessels gli gently over the waves.

By the means of two or three glasses, you may a represent a battle on land, or a naval engagement, witl variety of other pleasing experiments.

To produce the appearance of a Spectre on a Pedestal in Middle of a Table.

Enclose a small magic lantern in a box, (see Fig. 1 large enough to contain a small swing dressing-glass, whi

ct the light thrown on it by the lantern in such a
t it will pass out at the aperture made in the top
ox, which aperture should be oval, and of a size
.o the cone of light to pass through it. There
: a flap with hinges to cover the opening, that
: of the box may not be seen.

must be holes in that part of the box which is
lantern, to let the smoke out; and over this
placed a chaffing-dish of an oblong figure,
ugh to hold several lighted coals. This chaffing-
:he better carrying on the deception, may be in-
a painted tin box, about a foot high, with a hole
d should stand on four feet, to let the smoke from
n escape.

nust also be a glass planned to rise up and down
ve *a b*, and so managed by a cord and pulley,
at it may be raised up and let down by the cord
rough the outside of the box. On this glass,
re, (or any other figure you please,) must be
n a contracted or squat form, as the figure will
;reater length than it is drawn.

/ou have lighted the lamp in the lantern, and
: mirror in a proper direction, put the box on
nd setting the chaffing-dish in it, throw some
ı powder on the coals. You then open the
and let down the glass in the groove slowly,
you perceive the smoke diminish, draw up the
the figure may disappear and shut the trap

hibition will afford a deal of wonder; but ob-
: all the lights in the room must be extinguish-
he box should be placed on a high table, that
ıre may not be seen, through which the light
.

ıre many other pleasing experiments which
ıade with the magic lantern, but the limits of
will not permit us to specify them, without ex-
any other equally interesting subjects of a dif-
ıre.

The Artificial Landscape.

PROCURE a box (see Fig. 11.) of about a foot long, eight inches wide, and six inches high; or any other dimensions you please; so they do not greatly vary from these proportions. At each of its opposite ends, on the inside of this box, place a piece of looking-glass that shall exactly fit; but at that end where the sight-pole A is, scrape the quicksilver off the glass, through which the eye can view the objects.

Cover the box with gauze, over which place a piece of transparent glass, which is to be well fastened in. Let there be two grooves at each of the places C D E F, to receive two painted scenes as follow: On two pieces of pasteboard, let there be skilfully painted, on both sides, any subject you think proper, as woods, bowers, gardens, houses, &c. and on two other boards, the same subjects on one side only, and cut out all the white parts: observe also, that there ought to be in one of them some object relative to the subject placed at A, that the mirror placed at B may not reflect the whole on the opposite side.

The boards painted on both sides are to slide in the grooves C D E F, and those painted on one side are to be placed against the opposite mirrors A and B; then cover the box with its transparent top. This box should be placed in a strong light, to have a good effect.

When it is viewed through the sight-hole, it will present an unlimited prospect of rural scenery, gradually losing itself in obscurity; and be found well worth the pains bestowed on its construction.

To draw, easily and correctly, a Landscape, or any other object, without being obliged to observe the rules of perspective, and without the aid of the Camera Obscura.

PROCURE a box of pasteboard, A B C D, (Fig. 12.) of about a foot and a half long, and made in the shape of a truncated pyramid, whose base B D F G, is eight inches

wide and six inches high. Fix to the other end of it a tube of four or five inches long, and which you can draw out from the box more or less. Line the inside of the box with black paper, and place it upon a leg or stand of wood, H, and on which it may be elevated or depressed by the hinge, I.

Take a small frame of wood, and divide it at every inch by lines of black silk drawn across it, forming forty-eight equal parts; divide these into still smaller equal parts, by lines of finer silk*: fix this frame at the end of B D, as the base of the pyramid.

Provide a drawing paper, divided into the same number of parts as in the frame, by lines lightly drawn in pencil. It is not material of what size these divisions are; that will depend entirely on the size you propose to draw the objects by this instrument.

Place this instrument opposite a landscape, or any other object that you want to draw, and fix the leg firmly on, or in the ground, that it may not shake: then turning it to the side you choose, raise or incline it, and put the tube further in or out, till you have gained an advantageous view of the object you intend to draw.

Place your eye, E, by the instrument, which you have adjusted to the height of your eye, and looking through the tube, carefully observe all that is contained in each division of the frame, and transpose it to the corresponding division in your paper: and if you have the least knowledge in painting, or even drawing, you will make a very pleasing picture, and one in which all the objects will appear in the most exact proportion.

By the same method you may draw all sorts of objects, as architecture, views, &c. and even human figures, if they remain sometime in the same attitude, and are at a proper distance from the instrument.

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* The different thickness of the silk serve to distinguish more readily the corresponding divisions.

Illuminated Prospects.

PROVIDE yourself with some of those prints that commonly used in optical machines, printed on very white paper; taking care to make choice of such as l the greatest effect from the manner in which the obj are placed in perspective. Paste one of these on borders of a frame, and paint it carefully with the n lively colours, making use of none that are terres Observe, to retouch those parts several times where engraving is strongest,* then cut off the upper part sky, and fix that on another frame.

The prints being thus prepared, place them in a b ABCD, (Fig. 13 and 14,) the opening to which, EF should be a little less than the print. Cover this open with a glass, and paint all the space between that and prints, which should be about two or three inches, bla The frame that contains the sky should be about an i behind the other. In the back part of this box, whic behind the prints, and which may be about four inc deep, place four or five small candlesticks to hold w lights, and cover that part entirely with tin, that it may the more luminous.

When the print is placed between the wax lights a the opening in the front of the box, and there is no oth light in the room, the effect will be highly pleasin especially if the lights are at a sufficient distance fr each other, and not too strong, that they may not occasi any blots in the print. Those prints that represent t rising or setting of the sun will have a very picturesq appearance. Such as represent conflagrations have a a striking effect.

There should be two grooves for the print next t glass, that you may insert a second subject before y draw away the first: and that the lights in the back of t box may not be discovered.

You must not, thinking to make the print more tra

* When you colour a print, place it before you, against a piece of gl in a position nearly erect, that it may be enlightened by the sun. You a also cover both sides of the print.

nt, cover it with varnish; for that will prevent the ation of the colours from being visible. The frame ld enter the side of the box by a groove, that a varie- subjects may be introduced.

EXPERIMENTS IN MAGNETISM.

The Magnetic Wand.

RE a hole, three-tenths of an inch diameter, through und stick of wood; or get a hollow cane about eight es long, and half an inch thick. Provide a small rod, and let it be very strongly impregnated with od magnet; this rod is to be put in the hole you bored through the wand, and closed at each end by small ends of ivory that screw on, different in their es, that you may better distinguish the poles of the netic bar.

hen you present the north pole of this wand to the * pole of a magnetic needle, suspended on a pivot, a light body swimming on the surface of the water hich you have placed a magnetic bar,) that body will each the wand, and present that end which contains outh end of the bar; but if you present the north or end of the wand, to the north or south end of the le, it will recede from it.

The Mysterious Watch.

u desire any person to lend you his watch, and ask f it will go when laid on the table. He will, no doubt, will; in which case, you place it over the end of the et, and it will presently stop. You then mark the se spot where you placed the watch, and moving

* the more clearly explaining this, it is to be observed, that the two a magnet are called its poles. When placed on a pivot, in just equi-, that end which turns to the north is called the north pole, and the d the south pole.

the point of the magnet, you give the watch to anc person, and desire him to make the experiment which he not succeeding, you give it to a third (at same time replacing the magnet) and he will immedi perform it.

This experiment cannot be effected, unless you t very strongly impregnated magnetic bar, (which ma purchased at the opticians') and the balance of the w must be of steel, which may be easily ascertainec previously opening it, and looking at the works.

The Magnetic Dial.

Procure a circle of wood or ivory, of about 5 or 6 es diameter, which must turn quite free on a stand w circular border; on the ivory or wood circle fix a p board, on which you place in proper divisions, the h as on a dial. There must be a small groove in the c lar frame to receive the pasteboard circle, and obs that the dial must be made to turn so free, that it ma round without moving the circular border in which placed.

Between the pasteboard circle and the bottom of frame, place a small artificial magnet, that has a hole middle. On the outside of the frame, place a small which serves to shew when the magnetic needle is to This needle must turn quite free on its pivot, and it sides should be in exact equilibrio.

Then provide a small bag, with five or six divisions a lady's work bag, but smaller. In one of these divi put small square pieces of pasteboard, on which are ten the numbers from 1 to 12. In each of the oth visions put twelve or more similar pieces, observing all the pieces in each division must be marked wit same number. The needle being placed upon its pivot turned quickly about, it will necessarily stop at that where the north end of the magnetic bar is placed which you previously know, by the situation of the pin in the circular border.

You then present to any person that division o bag which contains the several pieces, on whi

the number opposite to the north end of the
d tell him to draw any one he pleases. Then
the needle on the pivot, you turn it quickly
and it must necessarily stop at that particular
.

The Magnetic Cards.

r a pasteboard circle; you then provide yourself
o needles, similar to those used in the foregoing
ıent, (which you must distinguish by some private
vith their opposite points touched with the magnet.
ou place that needle, whose pointed end is touch-
the pivot described in the centre of the circle, it
p on one of the four pips, against which you have
the pin in the frame; then take that needle off,
cing the other, it will stop at the opposite point.
ıg matters thus arranged, desire a person to draw
rom a piquet pack, offering that card against which
e placed the pin of the dial, which you may easily
having a card a little longer than the rest. If he
not draw it the first time, as he probably may not,
ıst make some excuse for shuffling them again,
letting the cards fall, as if by accident, or some
anœuvre, till he fixes on the card. You then tell
keep it close, and not let it be seen. Then give
of the two needles, and desire him to place it on
ot, and turn it round, when it will stop at the co-
the card he chose: then taking that needle off,
hanging it unperceived for the other, give it to
l person, telling him to do the same, and it will
the name of the identical card the first person

The Magnetic Orrery.

FRUCT a round box, (Fig. 15.) about eight inches
r, and half an inch deep. On the bottom fix a
pasteboard drawn like the figure. You are like-
have another pasteboard, drawn exactly the same,

which must turn freely in the box, by means of an
placed on a pivot, one end of which is to be fixed in
centre of the circle.

On each of the seven smaller circles on the pasteb
which you have fixed at the bottom of the box, pl
magnetic bar, two inches long, in the same direction
the diameters of those circles, and their poles, in
situations expressed in the figure.

There must be an index like the hour-hand of a
fixed on the axis of the central circle, by which
pasteboard circle in the box may be turned about;
a needle (forming in the figure the other hand) that
turn freely on the axis, without moving the cir
pasteboard.

In each of the places where the word *question* is, w
different question; and in each of the seven circles w
the planetary signs are, write two answers to each
tion; observing, that there must only be seven wor
each answer; for instance.

In division No. 1. of the circle G, which stands opp
question No. 1, write the first word of the first an
In the division No. 2, of the next circle, write the se
word; and so on to the last, which will be in the se
division of the seventh circle.

In the eighth division of the first circle, write the
word of the second answer; in the ninth, the second
of the same answer; and so on to the fourteenth di
of the seventh circle, which must contain the last w
that answer.

The same must be done for all the seven ques
and to each of these must be assigned two answers
words of which are to be dispersed through the
circles.

At the centre of each of these circles place a
and have two sets of magnetic needles like the hand
watch, the pointed end of one set being north, an
other south.

Now the index of the central circle being direct
any one of the questions, if you place one of th
magnetic needles on each of the seven lesser circles
will fix themselves according to the directions o

ars on the corresponding circles at the bottom of the ox, and consequently point to the seven words that compose the answer. If you place one of the other needles on each circle, it will point to the words that are diametrically opposite to those of the first answer, the north pole being in the place of the south pole of the other.

You therefore present this orrery to any person, and desire him to choose one of the questions there written. You then set the index of the central circle to that question and putting one of the needles on each of the seven circles, you turn it about, and when they all settle, the seven words they point to compose the answer.

The moveable needle, whose point in the figure stands at September, is to place against the names of the months; and when the party has fixed upon a question, you place that needle against the month in which he was born, which will make the ceremony appear a sort of magic divination. The planetary signs are merely intended to aid this deception, and give it the appearance of astrology.

The Magic Verse.

The eight words which compose this Latin verse,

"*Tot sunt tibi dotes quot cæli sidera virgo.*"*

being privately placed in any one of the different combinations, of which they are susceptible, and which are 40,320 in number, to tell the order in which they are placed.

Provide a box that shuts with hinges, and is eight inches long, three wide, and half an inch deep, (Fig. 16.) Have eight pieces of wood, about one-third of an inch, thick, two inches long, and one and a half wide, which will therefore, when placed close together, exactly fill the box. In each of these pieces or tablets place a magnetic bar, with their poles as is expressed in Fig. 17. The bars being covered over, write on each of the tablets, in the order

* "Thy charms, O Virgin! are as numerous as the stars of heaven."

they then stand, one of the words of the foregc verse.

On a very thin board of the same dimension box, draw the eight circles, (Fig. 17.) A B C D whose centres should be exactly over those of tablets in the box, when the board is placed Divide each of those circles into eight parts, figure, and in each of those divisions write o words of the Latin verse, and in the precise pressed in the plate, so that when the board over the box, the eight touched needles plac centre of the circles may be regulated by the pc bars in the box, and consequently the word that t points to in the circle be the same with that in the tablet. Cover the board with a glass to pr needles from rising off their pivots, as is done i compass.

Over the board place four plates of glass, (Fig. 16.) which will give the machine the fi truncated pyramid, of eight inches high. Cov a glass, or rather a board, in which are placed t O, of eight inches focus, and distant from each o half an inch. Line the four plates of glass tha the sides with very thin paper, that will admit and at the same time prevent the company fro the circles on the board.

These preparations being made, you give t any one, and tell him to place the tablets on words are wrote privately, in what position proper, then to close the box, and if he please, up in paper, seal it, and give it to you. The the board with the pyramid upon it, you im tell him the order in which the tablets are p reading the words to which the needles on t point.

ERESTING EXPERIMENTS WITH THE AIR PUMP.

ıall not occupy the time of our readers by de- the form and nature of the air pump; since those whose circumstances will enable them to have it, chase it properly made at an optician's, at less , and with far less trouble, than they can construct, : it to be constructed, themselves.

Bottles broken by Air.

: a square bottle of thin glass, and of any size. t to the hole in the air pump, and exhaust the air. ttle will sustain the weight of the external air as it is able, but at length it will suddenly burst into all particles, and with a loud explosion.
pposite effect will be produced, if the mouth of a e sealed so close that no air can escape; then place e receiver, and exhaust the air from its surface. r which is confined within the bottle, when the l air is drawn off, will act so powerfully as to break tle into pieces.

Glass broken by Air.

a square of glass on the top of an open receiver haust the air. The weight of the external air will n the glass, and smash it to atoms.

The hand fixed by Air.

person hold his hand on an open receiver and the :xhausted, it will be fixed as if pressed by a weight y pounds.

Water boiled by Air.

TAKE water made so warm that you can just be hand in it, but that has not been boiled; put it un receiver, and exhaust the air. Bubbles of air wi be seen to rise, at first very small, but presently b larger, and will be at last so great, and rise with s pidity, as to give the water the appearance of b This will continue till the air is let into the receive it will instantly cease.

Aërial Bubbles.

Take a stone, or any heavy substance, and pu in a large glass with water, place it in the receive air being exhausted, the spring of that which is pores of the solid body, expanding the particle make them rise on its surface in numberless g which resemble the pearly drops of dew on the the grass. The effect ceases when the air is let i receiver.

The floating Stone.

To a piece of cork tie a small stone that will j it; and putting it in a vessel of water, place it ur receiver. Then exhausting the receiver, the bu air will expand from its pores, and adhering to face, will render it, together with the stone, than water, and consequently they will rise to face and float.

Withered Fruit restored.

Take a shrivelled apple, and placing it ur receiver, exhaust the air. The apple will immedi plumped up, and look as fresh as when first gathe this reason, that the pressure of the external a taken off, the air in the apple extends it, so mucl that it will sometimes burst. If the air is let

:ceiver, the apple will be restored to its pristine shrivelled :ate.

Vegetable Air Bubbles.

Put a small branch of a tree with its leaves, or part of a small plant, in a vessel of water, and placing the vessel in the receiver, exhaust the air.

When the pressure of the external air is taken off, the spring of that contained in the air vessels of the plant, by expanding the particles, will make them rise from the orifices of all the vessels for a long time together, and produce a most beautiful appearance.

The Mercurial Wand.

Take a piece of stick, cut it even at each end with a penknife, and immerse it in a vessel of mercury. When the air is pumped out of the receiver, it will at the same time come out of the pores of the wood, through the mercury, as will be visible at each end of the stick. When the air is again let into the receiver, it falls on the surface of the mercury, and forces it into the pores of the wood to possess the place of the air.

When the rod is taken out it will be found considerably heavier than before, and that it has changed its colour, being now all over of a blueish hue. If cut transversely, the quicksilver will be seen to glitter in every part of it.

The Magic Bell.

Fix a small bell to the wire that goes through the top of the receiver. If you shake the wire, the bell will ring while the air is in the receiver; but when the air is drawn off, the sound will by degrees become faint till at last not the least noise can be heard. As you let the air in again, the sound returns.

Feathers heavier than Lead.

At one end of a fine balance, hang a piece of lead, and at the other, as many feathers as will poise it; then place the balance in the receiver. As the air is exhausted, the feathers will appear to overweigh the lead, and when all the air is drawn off, the feathers will preponderate, and the lead ascend.

The Self Moving Wheel.

Take a circle of tin, about ten inches in diameter, or of any other size that will go into the receiver, and to its circumference fix a number of tin vanes, each about an inch square. Let this wheel be placed between two upright pieces on an axis, whose extremities are quite small, so that the wheel may turn in a vertical position with the least possible force. Place the wheel and axis in the receiver, and exhaust the air. Let there be a small pipe with a cock; one end of the pipe to be outside the top of the receiver, and the other to come directly over the vanes of the wheel.

When the air is exhausted, turn the cock, and a current will rush against the vanes of the wheel, and set it in motion, which will increase, till the receiver is filled with air

*The Artificial Halo.**

Place a candle on one side of a receiver, and let the spectator place himself at a distance from the other side. Directly the air begins to be exhausted, the light of the candle will be refracted in circles of various colours.

Mercurial Shower.

Cement a piece of wood into the lower part of the neck of an open receiver, and pour mercury over it. After a few strokes of the pump the pressure of the air on the

* *Halo*, a circle of light round the sun.

mercury will force it through the pores of the wood in form of a beautiful shower. If you take care that the receiver is clear and free from spots or dust, and it is dry weather, it will appear like a fiery shower, if exhibited in a dark room.

Magic Fountain.

TAKE a tall glass tube, hermetically sealed both at top and bottom, by means of a brass cap screwed on to a stop cock, and that to the plate of the pump. When the air is exhausted, turn the cock, take the tube off the plate, and plunge it into a basin of mercury or water. Then the cock being again turned, the fluid, by the pressure of the air, will play upon the tube, in the form of a beautiful fountain.

The Exploded Bladder.

TAKE a glass pipe open at both ends, to one of which tie fast a wet bladder, and let it dry. Then place it on the plate of the pump. While the air presses the bladder equally on both sides, it will lie even and straight; but as soon as the air is exhausted, it will press inwards, and be quite concave on the upper side. In proportion as the air is exhausted, the bladder will become more stretched; it will soon yield to the incumbent pressure, and burst with a loud explosion. To make this experiment more easy, one part of the bladder should be scraped with a knife, and some of its external fibres taken off.

The Cemented Bladder.

TIE the neck of a bladder to a stop cock, which is to be screwed to the plate of the pump, and the air exhausted from the bladder; then turn the stop cock to prevent the re-entrance of the air, and unscrew the whole from the pump. The bladder will be transformed into two flat skins, so closely applied together, that the strongest man

cannot raise them half an inch from each other; for an ordinary sized bladder, of six inches across the widest part, will have one side pressed upon the other with a force equal to 396 pounds weight.

Cork heavier than Lead.

Let a large piece of cork be pendent from one end of a balance beam, and a small piece of lead from the other; the lead should rather preponderate. If this apparatus is placed under a receiver on the pump, you will find that when the air is exhausted, the lead, which seemed the heaviest body, will ascend, and the cork outweigh the lead. Restore the air, and the effect will cease. This phenomenon is only on account of the difference of the size in the two objects. The lead, which owes its heaviness to the operation of the air, yields to a lighter because a larger substance when deprived of its assistance.

The animated Bacchus.

Construct a figure of Bacchus, seated on a cask; let his belly be formed by a bladder, and let a tube proceed from his mouth to the cask. Fill this tube with coloured water or wine, then place the whole under the receiver. Exhaust the air, and the liquor will be thrown up into his mouth. While he is drinking, his belly will expand.

The Artificial Balloon.

Take a bladder containing only a small quantity of air, and a piece of lead to it, sufficient to sink it, if immersed in water. Put this apparatus into a jar of water, and place the whole under a receiver. Then exhaust the air, and the bladder will expand, become a balloon lighter than the fluid in which it floats, and ascend, carrying the weight with it.

Curious Experiment with a Viper.

natural philosophers, in their eagerness to display
ers of science, have overlooked one of the first
life, humanity; and, with this view, have tortured
ed many harmless animals, to exemplify the
effects of the air-pump. We, however, will not
pages of this little work by recommending any
cies of cruelty, which in many instances can merely
uriosity; but as our readers might like to read
t on animals, we extract from the learned Boyle,
nt of his experiment on a viper.
ok a newly-caught viper, and shutting it up in a
eiver, extracted the air. At first, upon the air's
awn away, it began to swell: a short time after
and opened its jaws; it then resumed its former
, and began to move up and down within the
as if to seek for air. After a while, it foamed a
ving the foam sticking to the inside of the glass:
r, the body and neck became prodigiously swelled,
lister appeared on its back. Within an hour
alf from the time the receiver was exhausted,
nded viper moved, being yet alive, though its
ained quite stretched; its black tongue reached
he mouth, which had also become black in the
n this situation it continued for three hours; but
air's being re-admitted, the viper's mouth was
y closed, and soon after opened again; and these
continued some time, as if there were still some
of life.
hus with animals of every kind; even minute
pical insects cannot live without air.

Experiments with Sparrows.

Morozzo placed successively several full grown
under a glass receiver, inverted over water. It
l with atmospheric air, and afterwards with vital
found,

First,—That in *atmospheric* air,

	HOURS.	MIN.
The first sparrow lived	3	0
The second sparrow lived	0	3
The third sparrow lived	0	1

The water rose in the vessels eight lines during the life of the first; four during the life of the second; and the third produced no absorption.

Second,—In *vital* air, or *oxygen*

	HOURS.	MIN.
The first sparrow lived	5	23
The second	2	11
The third	1	30
The fourth	1	10
The fifth	0	30
The sixth	0	47
The seventh	0	27
The eighth	0	30
The ninth	0	22
The tenth	0	21

The above experiments elicit the following conclusions:—1. That an animal will live longer in vital than in atmospheric air.—2. That one animal can live in air, in which another has died.—3. That, independent of air, some respect must be had to the constitution of the animal; for the sixth lived 47 minutes, the fifth only thirty.—4. That there is either an absorption of air, or the production of a new kind of air, which is absorbed by the water as it rises.

AMUSING EXPERIMENTS IN ELECTRICITY.

The Animated Feather.

Electrify a smooth glass tube with a rubber, and hold a small feather at a short distance from it. The feather will instantly fly to the tube, and adhere to it for a short time; it will then fly off, and the tube can never be brought close to the feather till it has touched the *side of the* room, or some other body that communicates

: ground. If, therefore, you take care to keep
e between the feather and the side of the room,
y drive it round to all parts of the room without
g it; and what is very remarkable, the same side
:ather will be constantly opposite the tube.
: the feather is flying before the smooth tube, it
immediately attracted by an excited rough tube or
of wax, and fly continually from one tube to the
ll the electricity of both is discharged.

The Candle lighted by Electricity.

SE a small coated phial, whose knob is bent
s so as to hang a little over the body of the phial;
ap some loose cotton over the extremity of a long
n or wire, so as to stick moderately fast to its
:e. Next roll this extremity of the pin which is
l up in cotton in some fine powdered resin; then
he extremity of the pin or wire to the external
of the charged phial, and bring as quickly as
the other extremity that is wrapped round with
o the knob: the powdered resin takes fire, and
ıicates its flame to the cotton, and both together
ıg enough to light a clandle. Dipping the cotton
f turpentine will do as well if you use a larger
.

Candle Bombs.

JRE some small glass bubbles, having a neck about
long, with very slender bores, by means of which
quantity of water is to be introduced into them,
orifice afterwards closed up. This stalk being
ıugh the wick of a burning candle, the flame boils
:r into a steam, and the glass is broken with a loud
ın.

The Artificial Spider.

a piece of burnt cork, about the size of a pea, into
pe of a spider; make its legs of linen thread, an

put a grain or two of lead in it to give it more
Suspend it by a fine line of silk, between an electrif
and an excited stick of wax; and it will jump co
from one body to the other, moving its legs at t
time, as if animated, to the great surprise of the unc
spectator.

The Miraculous Portrait.

Get a large print (suppose the king) with
and glass. Cut the print out about two inches f
frame all round; then with thin paste fix the bo
is left on the inside of the glass, pressing it smo
close; fill up the vacancy, by covering the glass v
leaf-gold or thin tin-foil, so that it may lie close.
likewise the inner edge of the bottom part of the
the frame with the same tin-foil, and make a c
cation between that and the tin-foil in the middl
glass; then put in the board, and that side is
Next turn up the glass, and cover the fore side witl
exactly over that on the back part; and when
paste over it the pannel of the print that was
observing to bring the corresponding parts of th
and pannel together, so that the picture will app
first, only part of it behind the glass, and par
Lastly, hold the print horizontally by the top, an
little moveable gilt crown on the king's head.

Now if the tin-foil on both sides of the glass b
rately electrified, and another person take hol
bottom of the frame with one hand, so that hi
touch the tin-foil, and with the other hand attemp
off the crown, he will receive a very smart blow,
in the attempt. The operator, who holds the fran
upper end, where there is no tin-foil, feels no
the shock, and can touch the face of the king
danger, which he pretends is a test of his loyalty.

The Cup of Tantalus.

You place a cup of any sort of metal on a stool
wood or a cake of wax. Fill it to the brim

liquor; let it communicate with the branch by a small chain; and when it is moderately electrified, desire a person to taste the liquor, without touching the cup with his hands, and he will instantly receive a shock on his lips. The motion of the wheel being stopped, you taste the liquor yourself, and desire the rest of the company to do so; you then give your operator (who is concealed in an adjoining room) the signal, and he again charges the cup; you desire the same person to taste the liquor a second time, and he will receive a second shock.

Magical Explosion.

Make up some gunpowder, in the form of a small cartridge, in each end of which put a blunt wire, so that the ends inside of the cartridge be about half an inch of each other; then joining the chain that proceeds from one side of the electrifying battery, to the wire at the other end, the shock will instantly pass through the powder, and set it on fire.

Artificial Earthquake.

In the middle of a large basin of water, lay a round wet board. On the board place any kind of building, made of pasteboard, of separate pieces, and not fastened together. Then fixing a wire that communicates with the two chains of the electrifying battery, so that it may pass over the board and the surface of the water, upon making the explosion, the water will become agitated as in an earthquake, and the board moving up and down, will overturn the structure, while the cause of the commotion is totally concealed.

The Magic Dance.

From the middle of the brass arch suspend three small bells. The two outer bells hang by chains, and the middle one by a silk string, while a chain connects it with the floor. *Two small* knobs of brass, which serve as clappers

hang by silk strings, one between each two bells. fore, when the two outer bells, communicating conductor, are electrified, they will attract the and be struck by them. The clappers being thu with electricity will be repelled, and fly to dischar selves upon the middle bell, after which they will attracted by the outer bells; and thus, by stri bells alternately, the ringing may be continued a the operator pleases.

You next suspend a plate of metal from the s of the arch to which the bells are connected; th distance of a few inches from the arch, and exact it, place a metal stand *of the same size.* On t place several figures of men, animals, or what yo cut in paper, and pretty sharply pointed at each e When the plate that hangs from the arch is electr figures will dance with astonishing rapidity, and will keep ringing to the no small entertainmen spectators.

The Electrical Fountain.

Suspend a vessel of water from the middle of arch, and place in the vessel a small tube. The w be one continued stream of water; and if the elect be strong, a number of streams will issue, in f cone, the top of which will be at the extremity of This experiment may be stopped and renew instantly, as if at the word of command.

The Electric Kite.

Make a small cross of two light strips of cedar, so long as to reach to the fou corners of a large handkerchief when extended; tie the corners of kerchief to the extremities of the cross; and you body of the kite, which being properly accommod a tail, loop, and string, will rise in the air like th

f paper; but this being of silk is more adapted to bear the vet and wind of a thunder gust, without tearing. To the op of the upright stick of the cross is to be fixed a very harp-pointed wire, rising a foot or more above the wood. To the end of the twine, is to be tied a silk ribbon, and where the silk and twine join, a key may be fastened. This kite is to be raised when a thunder storm appears to be coming on; and the person who holds the string must stand within a door or window, or under some cover, so that the silk ribbon may not be wet; and care must be taken that the twine do not touch the frame of the door or window. As soon as any of the thunder clouds come over the kite, the pointed wire will draw the electric fire from them, and the kite, with all the twine, will be electrified, while the loose filaments of the twine will stand out every way, and be attracted by an approaching finger. When the rain has wetted the kite and twine, so that it can conduct the electric fire freely, you will find it stream out plentifully from the key, on the approach of your knuckle. At this key an electric phial may be charged; and from electric fire thus obtained, spirits may be kindled, and all the other electric experiments performed, which are usually done by the help of a rubbed glass or tube, and thereby the identity of the electric matter with that of lightning completely demonstrated.

The Magic Chase.

On the top of a finely-pointed wire, rising perpendicularly from the conductor, let another wire, sharpened at each end, be made to move freely, as on a centre. If it be well balanced, and the points bent horizontally, in opposite directions, it will, when electrified, turn very swiftly round, by the re-action of the air against the current which flows from off the points. These points may be nearly concealed, and the figures of men and horses, with hounds, and a hare, stag, or fox, may be placed upon the wires, so as to turn round with them, when they will appear as if in pursuit. *The chase* may be diversified, and a greater

variety of figures put upon them, by increasing th
ber of wires proceeding from the same centre.

The Unconscious Incendiary.

Let a person stand upon a stool made of bake
or upon a cake of wax, and hold a chain which co
cates with the branch. On turning the wheel he
come electrified; his whole body forming part of th
conductor; and he will emit sparks whenever he i
ed by a person standing on the floor.

If the electrified person put his finger, or a rod
into a dish containing warm spirits of wine, it will
mediately in a blaze; and, if there be a wick or th
the spirit, that communicates with a train of gunp
he may be made to blow up a magazine, or set a
fire, with a piece of cold iron, and at the same tim
norant of the mischief he is doing.

The Inconceivable Shock.

Put in a person's hand a wire that is fixed on
hook that comes from the chain, which communicat
one side of the battery, and in his other hand put
wire with a hook at the end of it, which you direct
fix on the hook which comes from the other chai
attempting to do this, he will instantly receive a
from his body, without being able to guess the ca

Care should be taken that the shock be not too
and regard should be had to the constitution and
tion of the party, as a shock that would hardly aff
person, might be productive of very serious conseq
to another.

Much entertainment may be derived from con
the chain that communicates with that which pr
from the outside of the battery, under a carpe
placing the wire that communicates with the chai
the inside, in such a manner, that a person may

hand on it without suspicion, at the same time that his feet are upon the other wire.

The whole company may be made to partake of the shock, by joining hands, and forming a circle. The experiment may also be varied if they tread upon each other's toes, or lay their hands upon each other's heads. It might happen, by the latter method, that the whole company would be struck to the ground; but it will be productive of no danger, and very little inconvenience; on the contrary, it has happened that they have neither heard nor felt this shock.

To exhibit the five following amusements in Electricity, the chamber or room, in which they are performed, must be darkened.

The Miraculous Luminaries.

You must previous prepare the following phosphorus: Calcine common oyster-shells, by burning them in the fire for half an hour; then reduce them to powder; of the clearest of which take three parts, and of flowers of sulphur one part; put the mixture into a crucible, about an inch and a half deep. Let it burn in a strong fire for rather better than an hour; and when it is cool turn it out and break it in pieces; and taking those pieces into a dark place, scrape off those parts that shine brightest, which if good, will be a white powder.

Then construct a circular board, of three or four feet diameter, on the centre of which draw in gum water, or any adhesive liquid, a half moon, of three or four inches diameter, and draw a number of stars round it, at different distances, and of various magnitudes. Strew the phosphorus over the figures, to the thickness of about a quarter of an inch, laying one coat over the other. Place this board behind a curtain; and when you draw the curtain up or back, discharge one electrifying jar or phial over each figure, at the distance of about an inch, and they will become illuminated, exhibiting a very striking resemblance

of the moon and stars; and will continue to shine for about half an hour, their splendour becoming gradually more faint.

The Fiery Shower.

On the plate put a number of any kind of seeds, grains of sand, or brass dust. The conductor being strongly electrified, those light particles will be attracted and repelled by the plate suspended from the conductor, with amazing rapidity, so as to exhibit a perfect fiery shower.

Another way is by a sponge that has been soaked in water. When this sponge is first hung to the conductor, the water will drop from it very slowly; but when it is electrified, the drops will fall very fast, and appear like small globes of fire, illuminating the basin into which they fall.

The Illuminated Vacuum.

Take a tall receiver that is very dry, and fix through the top of it, with cement, a blunt wire; then exhaust the receiver, and present the knob of the wire to the conductor, and every spark will pass through the vacuum, in a broad stream of light, visible through the whole length of the receiver, let it be as tall as it will. This generally divides into a variety of beautiful rivulets, which are continually changing their course, uniting and dividing again in the most pleasing manner.

If a jar be discharged through this vacuum, it presents the appearance of a very dense body of fire, darting directly through the centre of the vacuum, without touching the sides; whereas, when a single spark passes through, it generally goes more or less to the side, and a finger placed on the outside of the glass, will draw it wherever a person pleases. If the vessel be grasped by both hands, every spark is felt like the pulsation of a large artery; and all the fire makes towards the heads. This pulsation is even felt at some distance from the receiver, and a light is seen between the hand and the glass.

ı while the pointed wire is supposed to be electri-
ively; if it be electrified negatively, the appear-
tonishingly different; instead of streams of fire,
ı seen but one uniform luminous appearance, like
oud, or the *milky way* in a clear star-light night.
ı reaches the whole length of the vessel, but
appears only at the end of the wire, like a lucid

nall phial be inserted in the neck of a small
so that the external surface of the glass be exposed
uum, it will produce a very beautiful appearance.
l must be coated on the inside, and while it is
at every spark taken from the conductor into
, a flash of light is seen to dart at the same time
y part of the external surface of the phial, so as
ll the receiver. Upon making the discharge, the
een to run in a much closer body, the whole
ut at once.

The Illuminated Cylinder.

ı a glass cylinder, three feet long, and three
ıneter; near the bottom of it fix a brass plate,
another brass plate, so contrived that you may
n the cylinder, and bring it as near the first plate
ire. Let this cylinder be exhausted and insulated,
the upper part is electrified, the electric matter
from one plate to the other, when they are at the
distance from each other that the cylinder will
The brass plate at the bottom of the cylinder will
strongly electrified as if it were connected by a
ıe prime conductor.
ectric matter, as it passes through this vacuum,
a most brilliant spectacle, exhibiting sparkling
fire the whole length of the tube, and of a bright
, representing the most lively exhalations of the
realis.

The Electric Aurora Borealis.

MAKE a Torricellian vacuum* in a glass tube, abo three feet long, and hermetically sealed†. Let one end this tube be held in the hand, and the other applied to th conductor; and immediately the whole tube will be ill minated from one end; and when taken from the conduct will continue luminous, without interruption, for a co siderable time, very often above a quarter of an hour. I after this, it be drawn through the hand either way, th light will be uncommonly brilliant, and, without the les interruption, from one hand to the other, even to its whol length. After this operation, which discharges it in measure, it will still flash at intervals, though it be hel only at one extremity, and quite still; but if it be grasp by the other hand at the same time, in a different plac strong flashes of light will dart from one end to the othe This will continue for twenty-four hours, and often long without any fresh excitation. Small and long glass tube exhausted of air, and bent in many irregular crooks a angles, will, when properly electrified, exhibit a ve beautiful representation of vivid flashes of lightning.

The Electrical Orrery.

BY the motion of circulating points, we may in so measure imitate the revolutions of the heavenly bodie forming what is called the *Electrical Orrery*. Let single wire, with the extremities pointed and turned, b nicely balanced on a point; fix a small glass ball over centre to represent the sun. At one extremity of th wire, let a small wire be soldered perpendicularly, and o this balance another small wire with its ends pointed a turned, and having a small pith ball in its centre

* A Torricellian vacuum is made by filling a tube with pure mercury, a then inverting it, in the same manner as in making a barometer; for as mercury runs out, all the space above will be a true vacuum.

† A glass is hermetically sealed by holding the end of it in the flame of candle, till it begins to melt, and then twisting it together with a pair pincers.

represent the earth, and a smaller ball of the same kind at one of the angles for the moon. Let the whole be supported upon a glass pillar, and be conducted by a chain proceeding from the prime conductor to the wire supporting the glass ball. Now, when the machine is put in motion, the wires will turn round, so that the ball representing the earth will move round the central ball, and the little ball at the angle of the smaller wire will at the same time revolve about the earth.

The Electrified Cotton.

Take a small lock of cotton, extended in every direction as much as can conveniently be done, and by a linen thread about five or six inches long, or by a thread drawn out of the same cotton, tie it to the end of the prime conductor; then set the machine in motion, and the lock of cotton on being electrified, will immediately swell, by repelling its filaments from one another, and will stretch itself towards the nearest conductor. In this situation let the cylinder be kept in motion, and present the end of your finger, or the knob of a wire, towards the lock of cotton, which will then immediately move towards the finger, and endeavour to touch it; but take with the other hand a pointed needle, and present its point towards the cotton, a little above the end of the finger, and the cotton will be observed immediately to shrink upwards, and move towards the prime conductor. Remove the needle, and the cotton will come again towards the finger. Present the needle, and the cotton will shrink again.

The Electric Sparks.

When the prime conductor is situated in its proper place, and electrified by whirling the cylinder, if a metallic wire, with a ball at its extremity, or the knuckle of a finger, be presented to the prime conductor, a spark will be seen to issue between them, which will be more vivid, and will be attended with a greater or less explosion, according as the ball is larger. The strongest and most

vivid sparks are drawn from that end or side of the prime conductor which is farthest from the cylinder. The sparks have the same appearance whether they be taken from the positive or the negative conductor; they sometimes appear like a long line of fire reaching from the prime conductor to the opposed body, and often (particularly when the spark is long, and different conducting substances in the line of its direction) it will have the appearance of being bent to sharp angles in different places, exactly resembling a flash of lightning.

The figure of the spark varies with the superficial dimensions of the part from which it is taken. If it be drawn from a ball of two or three inches in diameter, it will have the appearance of a straight line; but if the ball from which it is drawn be much smaller, as half an inch in diameter, it will assume the zig-zag appearance above mentioned.

Dancing Balls.

Take a common tumbler or glass jar, and having placed a brass ball in one of the holes of the prime conductor, set the machine in motion, and let the balls touch the inside of the tumbler; while the ball touches only one point, no more of the surface of the glass will be electrified, but by moving the tumblers about so as to make the ball touch many points successively, all these points will be electrified, as will appear by turning down the tumbler over a number of pith or cork balls placed on a table. These balls will immediately begin to fly about.

The Leyden Phial.

When a nail or a piece of thick brass-wire, &c. is put into a small apothecary's phial, and electrified, remarkable effects follow; but the phial must be very dry or warm. Rub it once beforehand with your finger, on which put some pounded chalk. If a little mercury, or a few drops of spirit of wine, be put into it, the experiment succeeds the better. As soon as this phial and nail are removed from the electrifying glass, or the prime conductor to

ich it has been exposed, is taken away, it throws out a ncil of flame so long, that with this burning machine in ur hand, you may take about sixty steps in walking about ur room. When it is electrified strongly, you may take into another room, and there fire spirits of wine with it.

while it is electrifying, you put your finger, or a piece gold which you hold in your hand, to the nail, you re-ive a shock which stuns your arms and shoulders.

A tin tube, or a man placed upon electrics, is electrified uch stronger by this means than in the common way. hen you present this phial and nail to a tin tube, fifteen et long, nothing but experience can make a person elieve how strongly it is electrified. Two thin glasses ve been broken by the shock of it. It appears extra-dinary, that when this phial and nail are in contact ith either conducting or non-conducting matter, the rong shock does not follow.

The Self-Moving Wheel.

The self-moving wheel is made of a thin round plate of indow glass, seventeen inches in diameter, well gilt on oth sides, to within two inches of the circumference. wo small hemispheres of wood are then fixed with ement, to the middle of the upper and under sides, entrally opposite, and in each of them a thick strong ire, eight or ten inches long, making together the axis f the wheel. It turns horizontally on a point at the wer end of its axis, which rests on a bit of brass cement-d within a glass salt-cellar. The upper end of its axis sses through a hole in a thin brass plate, cemented to long and strong piece of glass; which keeps it six or ght inches distant from any non-electric, and has a small ll of wax or metal on its top.

In a circle on the table which supports the wheel, are ted twelve small pillars of glass, at about eleven inches stance, with a thimble on the top of each. On the edge the wheel is a small leaden bullet, communicating by a re with the upper surface of the wheel; and about six hes from it, is another bullet, communicating, in like

manner, with the under surface. When the wheel is t be charged by the upper surface, a communication mu be made from the under surface with the table.

When it is well charged it begins to move. The bulle nearest to a pillar moves toward the thimble on the pillar, and passing by, electrifies it, and then pushes itsel from it. The succeeding bullet, which communicates wit the other surface of the glass, more strongly attracts the thimble, on account of its being electrified before by the other bullet, and thus the wheel increases its motion, til the resistance of the air regulates it. It will go half a hour, and make, one minute with another, twenty turns in a minute, which is six hundred turns in the whole, the bullet of the upper surface giving in each turn twelve sparks to the thimbles, which make seven thousand two hundred sparks, and the bullet of the under surface receiving as many from the thimble, these bullets moving in the time nearly two thousand five hundred feet. The thimbles should be well fixed, and in so exact a circle, that the bullets may pass within a very small distance of each of them.

If instead of two bullets you put eight, four communicating with the upper surface, and four with the under surface, placed alternately, (which eight, at about six inches distance, complete the circumference) the force and swiftness will be greatly increased, the wheel making fifty turns in a minute, but then it will not continue moving so long.

Rosin ignited by Electricity.

Wrap some cotton wool, containing as much powdered rosin as it will hold, about one of the knobs of a discharging rod. Then having charged a Leyden jar, apply the naked knob of the rod to the external coating, and the knob enveloped by the cotton to the ball of the wire. The act of discharging the jar will set fire to the rosin.

A piece of phosphorus or camphor wrapped in cotton wool, and used in the same way, will be much more easily inflamed.

Spirits ignited by Electricity.

HANG a small ball with a stem to the prime conductor so that the ball may project below the conductor. Then warm a little ardent spirit, by holding it a short time over a candle in a metallic spoon; hold the spoon about an inch below the ball, and set the machine in motion. A spark will soon issue from the ball and set fire to the spirits.

This experiment may be varied different ways, and may be rendered very agreeable to a company of spectators. A person for instance, standing upon an electric stool, and communicating with the prime conductor, may hold the spoon with the spirits in his hand, and another person, standing upon the floor, may set the spirits on fire, by bringing his finger within a small distance of it. Instead of his finger he may fire the spirits with a piece of ice; when the experiment will seem much more surprising. If the spoon be held by the person standing upon the floor, and the insulated person bring some conducting substance over the surface of the spirit, the experiment succeeds as well.

The Electric Balloon.

Two balloons, made of the allantoides of a calf, are to be filled with hydrogen gas, of which each contains about two cubic feet. To each of these is to be suspended, by a silken thread about eight feet long, such a weight as is just sufficient to prevent it from rising higher in the air; they are connected, the one with the positive, the other with the negative conductor, by small wires about 30 feet in length; and being kept near 20 feet asunder, are placed as far from the machine as the length of the wires will admit. On being electrified, these balloons will rise up in the air as high as the wire will allow, attracting each other, and uniting as it were into one cloud, gently descending.

The Illuminated Water.

CONNECT one end of a chain with the outside of a charged phial, and let the other end lie on the table:

Place the end of another piece of chain at the distance o about a quarter of an inch from the former; and set glass decanter of water on these separated ends. O making the discharge, the water will appear perfectl luminous.

The electric spark may be rendered visible in water, i the following manner. Take a glass tube of about half a inch in diameter, and six inches long; fill it with wate and to each extremity of the tube adapt a cork, which ma confine the water; through each cork insert a blunt wir so that the extremities of the wires within the tube may b very near one another; then, on conducting one of the wires with the coating of a small charged phial, an touching the other wire with the knob of it; the shoc will pass through the wires, and cause a vivid spark t appear between their extremities within the tube. Th charge in this experiment must be very weak, or there wi be danger of bursting the tube.

The Electrified Ball.

Place an ivory ball on the prime conductor of th machine, and take a strong spark, or send the charge of Leyden phial through its centre, and the ball will appe perfectly luminous: but if the charge be not sent throug the centre, it will pass over the surface of the ball an singe it. A spark made to pass through a ball of box-woo not only illuminates the whole, but makes it appear of beautiful crimson, or rather fine scarlet colour.

Illuminated Phosphorus.

Put some of Canton's phosphorus into a clear gla phial, and stop it with a glass stopper, or a cork an sealing-wax. If this phial be kept in a darkened roo (which for this experiment must be very dark) it will gi no light: but let two or three strong sparks be drawn fro the prime conductor, when the phial is kept at about tw inches distant from the sparks, so that it may be expo

light, and this phial will receive the light, and after-
will appear illuminated for a considerable time.
powder may be stuck upon a board by means of
ite of an egg, so as to represent figures of planets,
or any thing else, at the pleasure of the operator,
ese figures may be illuminated in the dark, in the
ıanner as the above described phial.
antiful method of expressing geometrical figures
.e above powder, is to bend small glass tubes, of
he tenth part of an inch diameter, in the shape of
ıre desired, and then to fill them with the phospho-
der. These may be illuminated in the manner de-
.; and they are not so subject to be spoiled, as the
represented upon the board frequently are.

The Luminous Writing.

.L pieces of tin-foil may be stuck on a flat piece of
io as to represent various fanciful figures. Upon
ıe principle is the word LIGHT produced, in lumi-
ıaracters.
'ormed by the small separations of the tin-foil past-
a piece of glass fixed in a frame of baked wood.
this, the frame must be held in the hand, and the
:sented to the conductor. The spark will then be
:d in the intervals composing the word; from
: it passes to the hook, and thence to the ground by
. The brilliancy of this is equal to that of the spiral

The Electric Explosion.

: a card, a quire of paper, or the cover of a book,
:p it close to the outside coating of a charged jar;
: knob of the discharging rod upon the card, quire
:r, &c. so that between the knob and coating of the
thickness of that card or quire of paper only is
sed; lastly, by bringing the other knob of the
ging rod near the knob of the jar, make the dia-
and the electric spark will pierce a hole (or perhaps

several) quite through the card or quire of paper hole has a bur raised on each side, except the card, pressed hard between the discharging rod and the this experiment be made with two cards instead which however must be kept very little distant fr another, each of the cards, after the explosion, found pierced with one or more holes, and each h have burs on both surfaces of each card. The h holes, are larger or smaller, according as the card more damp or more dry. It is remarkable, the nostrils are presented to it, they will be affected sulphureous, or rather a phosphoric smell, just l produced by an excited electric.

If, instead of paper, a very thin plate of glass, sealing-wax, or the like, be interposed between th of the discharging rod and the outside coating of on making the discharge, this will be broken in pieces.

Electrified Air.

Fix two or three pointed needles into the prin ductor of an electrical machine, and set the glass in so as to keep the prime conductor electrified for minutes. If now, an electrometer be brought wit air that is contiguous to the prime conductor, it hibit signs of electricity, and this air will continue fied for some time, even after the machine has b moved into another room. The air, in this case, trified positively; it may be negatively electrified ing the needles in the negative conductor while ins and making a communication between the prim ductor and the table, by means of a chain or oth ducting substance.

The air of a room may be electrified in anothe Charge a large jar, and insulate it; then connect more sharp pointed wires or needles, with the knob jar, and connect the outside coating of the jar w table. If the jar be charged positively, the air of th will soon become positively electrified likewise; bu jar be charged negatively, the electricity communic

: air, will become also negative. A charged jar eld in one hand, and the flame of an insulated ıeld in the other being brought near the knob of will also produce the same effect.

Another Electric Orrery, (See p. 94.)

:he prime conductor of an electric machine suspend :entric hoops of metal at different distances from ther, in such a manner as to represent in some the proportional distances of the planets. Under ıd at a distance of about half an inch, place a plate, and upon this plate, within each of the . glass bubble blown very thin and light. On ing the hoops, the bubbles will be immediately l by them, and will continue to move round the ı long as the electrification continues. If the :y be very strong, the bubbles will frequently be ff, run hither and thither on the plate, making a f surprising motions round their axis; after which . return to the hoop, and circulate as before; and om be darkened, they will appear beautifully ed with the electric light.

The Electric Ball.

DE a ball of cork about three quarters of an inch ter, hollowed out in the internal part by cutting it ıemispheres, scooping out the inside, and then hem together with paste. Having attached this to ead between three and four feet in length, suspend ı a manner that it may just touch the knob of an ar, the outside of which communicates with the On the first contact it will be repelled to a con- distance, and after making several vibrations will ıtationary; but if a candle is placed at some behind, it, so that the ball may be between it and e, the ball will instantly begin to move, and will ıd the knob of the jar, moving in a kind of ellipsis as there is any electricity in the bottle. This

The Ten Duplicates.

SELECT any twenty cards; let any person shuffle t lay them by pairs on the board, without looking at t You next desire several persons,(as many persons as are pairs on the table,) each to look at different pair remember what cards compose them. You then ta all the cards in the order they lay, and replace them their faces uppermost on the table, according to the of the letters in the following words:

M	U	T	U	S
1	2	3	4	5
D	E	D	I	T
6	7	8	9	10
N	O	M	E	N
11	12	13	14	15
C	O	C	I	S
16	17	18	19	20

(These words convey no meaning.)—You will observe they contain ten letters repeated, or two of each sort. therefore ask each person which row or rows the ca looked at are in; if he say the first, you know they be the second and fourth, there being two letters of (two U's) in that row; if he say the second and f they must be the ninth and nineteenth, (two I's) and the rest. This amusement, which is very simple requires very little practice, will be found to exci those who are unacquainted with the key, the gr astonishment.

The readiest way is to have a fac-simile of the key on a card, to which you refer.

To tell how many Cards a Person takes out of a and to specify each Card.

To perform this you must so dispose a PIQUET p cards, that you can easily remember the order in

y are placed. Suppose, for instance, they are placed ordling to the words in the following line:

Seven Aces, Eight Kings, Nine Queens, and Ten Knaves;

. that every card be of a different suite, following each er in this order: spades, clubs, hearts, and diamonds. en the eight first cards will be the seven of spades, ace lubs, eight of hearts, king of diamonds, nine of spades, en of clubs, ten of hearts, and knave of diamonds, and f the rest.

'ou shew that the cards are placed promiscuously, and offer them with their backs upward to any one, that he draw what quantity he pleases; you then dexterously k at the card that precedes, and that which follows e he has taken. When he has carefully counted the ls, which is not to be done in your presence (and, in er to give you time for recollection, you will tell him o it twice over, that he may be certain), you then take n from him, mix them with the pack, shuffle, and tell to shuffle.

uring all this time you recollect, by the foregoing line, he cards he took out; and as you lay them down, one me, you name each card.

nless a person has a most excellent memory, he had er not attempt the performance of the above amuse- t, as the least forgetfulness will spoil the whole, and e the operator appear ridiculous.

undred different Names being written on the Cards, to tell the particular Name any Person thought of.

RITE on ten cards a hundred different names, observ- that the last name on each card begins with one of etters in the word INDROMACUS, which letters, in rder they stand, answer to the numbers 1 to 10, thus:

I	N	D	R	O	M	A	C	U	S
1	2	3	4	5	6	7	8	9	10

en other cards write the same names, with this restric- that the first name on every card must be taken from

the first of the other cards, whose last name begins with I; the second name must be taken from that whose last name begins with N; and so of the rest. Then let any person choose a card out of the first ten, and after he has fixed on a name give it to you again, when you carefully note the last name, by which you know the number of that card. You then take the other ten cards, and, after shuffling them, shew them to the person, and ask if he sees the name he chose, and when he answers in the affirmative, you look to that name which is the same in number from the top with the number of the card he took from the other parcel, and that will be the name he fixed on.

Instead of ten cards there may be twenty to each parcel, by adding duplicates to each card, which will make it appear more mysterious, and will not at all embarrass it, as you have only to remember the last name on each card. Instead of names you may write questions on one of the parcels, and answers on the other.

Several different Cards being fixed on by different Persons, to name that on which each Person fixed.

There must be as many different cards shewn to each *person*, as there are cards to choose; so that, if there are three persons, you must shew three cards to each person, telling the first to retain *one* in his memory. You then lay those three cards down, and shew three others to the second person, and three others to the third. Next take up the first person's cards, and lay them down separately, one by one, with their faces upwards; place the second person's cards over the first, and the third over the second's, so that there will be one card in each parcel belonging to each person. You then ask each of them in which parcel his card is, and by the answer, you immediately know which card it is; for the first person's will always be the first, the second person's the second, and the third person's the third in that parcel where each says his card is.

This amusement may be performed with a single person,

by letting him fix on three, four, or more cards. In this case you must shew him as many parcels as he is to choose cards, and every parcel must consist of that number, out of which he is to fix on one, and you then proceed as before, he telling you the parcel that contains each of his cards.

To name the Rank of a Card that a Person has drawn from a Piquet Pack.

The rank of the card means whether it be an ace, king, queen, &c. You therefore first fix a certain number to each card; thus you call the king four, the queen three, the knave two, the ace one, and the others according to the number of their pips.

You then shuffle the cards, and let a person draw any one of them; then turning up the remaining cards, you add the number of the first to that of the second, the second to the third, and so on, till it amounts to ten; which you then reject, and begin again; or if it be more, reject the ten, and carry the remainder to the next card, and so on to the last; and to the last amount add four, and subtract that sum from ten, if it be less, or from twenty, if it be more than ten, and the remainder will be the number of the card that was drawn; as for example, if the remainder be two, the card drawn was a knave, if three a queen, and so on.

To tell the Amount of the Numbers of any Two Cards drawn from a common Pack.

Each court card in this amusement counts for ten, and the other cards according to the number of their pips. Let the person who draws the cards add as many more cards to each of those he has drawn as will make each of their numbers twenty-five. Then take the remaining cards in your hand, and, seeming to search for some card among them, tell them over to yourself, and their number will be the amount of the two cards drawn.

For example:—Suppose the person has drawn a and a seven, then he must add fifteen cards to the firs make the number twenty-five, and eighteen to the las the same reason; now fifteen and eighteen make th three, and the two cards themselves make thirty- which deducted from fifty-two, leaves seventeen, w must be the number of the remaining cards, and als the two cards drawn.

You may perform this amusement without touching cards, thus:

Let the person who has drawn the two cards deduct number of each of them from twenty-six, which is hal number of the pack, and after adding the remainder gether, let him tell you the amount, which you priv deduct from fifty-two, the total number of all the c and the remainder will be the amount of the two car

Example. Suppose the two cards to be as before, and seven; then the person deducting ten from tw six, there remain nineteen; these two remainders a together make thirty-five, which you subtract from two, and there must remain seventeen for the amou the two cards, as before.

To tell the Amount of the Numbers of any Three C that a Person shall draw from the Pack.

After the person has drawn his three cards, draw yourself, and lay it aside, for it is necessary that the ber of the remaining cards be divisible by three, w they will not be in a pack of fifty-two cards, if only be drawn. The card you draw, you may call the c derate, and pretend it is by the aid of that card you dis the amount of the others. Then tell the party to a many more to each of his cards as will make its nu sixteen, which is the third part of the remaining eight cards; therefore, suppose he has drawn a t seven, and a six: then, to the first he must add six to the second, nine, and to the third, ten, which tog make twenty-five, and the four cards drawn being add

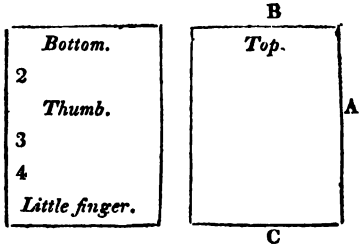
ıem, make twenty-nine. You then take the remaining ırds, and telling them over, as in the last amusement, ɔu find their number to be twenty-three, the amount of ıe three cards the person drew.

This amusement may also be performed without touch-g the cards, thus:—When the party has drawn his three ırds, and you have drawn one, let him deduct the number f each of the cards he has drawn from seventeen, which ı one-third of the pack after you have drawn your card; nd let him tell you the amount of the several remainders, ɔ which you privately add one to the card you drew, and educting that amount from fifty-two, (the whole number f the cards) the remainder will be the amount of the hree cards drawn.

Example. Suppose the three cards to be ten, seven, and ix, as before; then, each of those numbers, subtracted ɔm seventeen, the remainders will be, respectively, even, ten, and eleven, which, added together, make wenty-eight, to which the single card you drew being eckoned as one, and added, makes twenty-nine; and that umber deducted from fifty-two, leaves twenty-three, hich is the amount of the three cards the party drew.

The following amusements principally depend on dex-erity of hand; and, as what is termed *making the pass*, ill be necessary to be acquired, to enable the operator to erform many of them, we subjoin the following expla-ation of this term:

How to make the Pass.—Hold the pack of cards in your ght hand, so that the palm of your hand may be under ıe cards: place the thumb of that hand on one side of ıe pack; the first, second, and third fingers on the other de, and your little finger between those cards that are to ɔ brought to the top, and the rest of the pack. Then ace your left hand over the cards in such a manner that e thumb may be at C, the fore-finger at A, and the her fingers at B, as in the following figure:



The hands and the two parts of the cards bein disposed, you draw off the lower cards, confined little finger and the other parts of the right han place them, with an imperceptible motion, on the the pack.

But before you attempt any of the tricks that dep *making the pass*, you must have great practice, able to perform it so dexterously and expeditiousl the eye cannot detect the movement of the hand; may, instead of deceiving others, expose yourself.

The Long Card.—Another stratagem, connecte the performance of many of the following tricks, i is termed *the long card;* that is, a card, either longer or wider than the other cards, not percepti the eye of the spectator, but easily to be distinguis the touch of the operator.

The Divining Card.

Provide a pack in which there is a long card; c at that part where the long card is, and present th to a person in such a manner that he will naturall that card. You then tell him to put into any part pack, and shuffle the cards. You take the pack, an the same card in like manner to a second or third p taking care that they do not stand near enough to s card each other draws.

en draw several cards yourself, among which is
card, and ask each of the parties if his card be
ose cards, and he will naturally say *yes*, as they
lrawn the same card. You then shuffle all the
;ether, and cutting them at the long card, you
fore the first person, so that the others may not
d tell him that is his card. You then put it in
, shuffle it, cut it again at the same card, and
the second person.

n perform this recreation without the long card,
owing manner:

erson draw any card, and replace it in the pack.
make the pass, (see p. 111) and bring that card
of the pack, and shuffle them, without losing
ıat card. You then offer that card to a second
at he may draw it, and put it in the middle of the
ou *make the pass*, and shuffle the cards a second
he same manner, and offer the card to a third
ıd so again to a fourth or fifth.

The Four Confederate Cards.

ıx draws four cards from the pack, and you tell
nember one of them. He then returns them to
and you dexterously place two under and two
of the pack. Under the bottom ones you place
of any sort, and then taking eight or ten from
n cards, you spread them on the table, and ask
n if the card he fixed on be among them. If
you are sure it is one of the two cards on the
then pass those two cards to the bottom; and
ff the lowest of them, you ask if that is not his
ıe again say *no*, you take up that card, and bid
his card from the bottom of the pack.—If, on
ıry, he say his cards *are* among those you *first*
the bottom, you must dexterously take up the
you put under them, and placing those on the
ıe other two be the bottom cards of the pack,
ı are to draw in the manner before described.

The Numerical Card.

Let the long card be the sixteenth in a pack of picqu cards. Take ten or twelve cards from the top of the pac and spreading them on the table, desire a person to thi on any one of them, and to observe the number it is fr the first card. Make the pass at the long card, which w then be at the bottom. Then ask the party the number card was at, and counting to yourself from that numbe sixteen, turn the cards up, one by one, from the botto Then stop at the seventeenth card, and ask the perso he has seen his card, when he will say *no*. You then i him how many more cards you shall draw before his c appears; and when he has named the number, you dr the card aside with your finger, turn up the numbe cards he proposed, and throw down the card he fixed

The Card found out by the Point of a Sword.

When a card has been drawn, you place it under long card, and by shuffling them dexterously, you b it to the top of the pack. Then lay, or throw the pac the ground, observing where the top card lies. A hu kerchief is then bound round your eyes, which ought t done by a confederate in such a way that you can see ground. A sword is put into your hand, with which touch several of the cards, as if in doubt, but never lo sight of the top card, in which at last you fix the poi the sword, and present to the party who drew it.

The Card hit upon by Guess.

Spread part of a pack before a person, in such a that only one court card is visible; and so arrange it, it shall appear the most prominent and striking card. desire him to think on one; and observe if he fix his on the court card. When he tells you he has determ on one, shuffle the card, and turning them up one by when you come to the court card tell him that is the

he does not seem to fix his eye on the court card, hould not hazard the experiment; but frame an ex- for performing some other amusement; neither d it be attempted with those who are conversant with sort of deceptions.

The Card changed by Word of Command.

u must have two cards of the same sort in the pack, e king of spades. Place one next the bottom card, seven of hearts) and the other at top. Shuffle the without displacing those three, and shew a person he bottom card is the seven of hearts. This card you rously slip aside with your finger, which you have ously wetted, and taking the king of spades from the m, which the person supposes to be the seven of s, lay it on the table, telling him to cover it with his

uffle the cards again, without displacing the first and ard, and shifting the other king of spades from the o the bottom, shew it to another person. You then that privately away, and taking the bottom card, h will then be the seven of hearts, you lay that on the , and tell the second person (who believes it to be ing of spades) to cover it with his hand.

u then command the cards to change places; and the two parties take off their hands, and turn up ards, they will see to their great astonishment, that commands are obeyed.

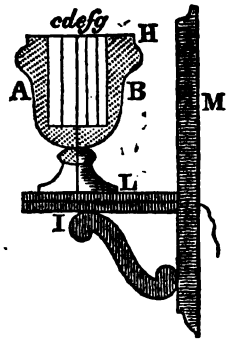
The Three Magical Parties.

TER the long card to a person that he may draw it, eplace it in any part of the pack he pleases. *Make the* and bring that card to the top. Next divide the pack ree parcels, putting the long card in the middle heap. then ask the person which of the three heaps his card be in. He will, probably, say the middle; in which you immediately shew it to him. But if he say either

of the others, you take all the cards in your hand, pl
the parcel he has named over the other two, and ol
ing to put your little finger between that and the n
heap, at the top of which is the card he drew. You
ask at what number in that heap he will have his ca
pear. If, for example, he say the sixth, you tell dow
cards from the top of the pack, and then dexterously
ing the pass, you bring the long card to the top, an
it down as the sixth.

The Magic Vase.

CONSTRUCT a vase of wood, or pasteboard. (See Fig



On the inside let there be five divisions; two of t
c, d, to be large enough to admit a pack of cards e
and the other three, *e, f, g,* only large enough to con
single card. Place this vase on a bracket L, whi
fastened to the partition M. Fix a silken thread at H
other end of which passes down the division *d,* and
the pulley I, runs along the bracket L, and goes ou
hind the partition M.

Take three cards from a picquet pack, and place
of them in each of the divisions, e, f, g, making the

[illegible]

[illegible]

[illegible]

you lay each card down, shew it to the person, seeing it yourself. When you have completed th parcels, ask him at what number, from one to seven, he will have his card appear, and in whic it then is. You then look at the heap through you and if the first of the three numbers, which stands the number it is to appear at, be one, put that top; if the number be two, put it in the middle; be three, put it at bottom. Next divide the car three heaps in the same manner, a second and thi and his card will be at the number he chose.

Example.—Suppose the person wishes his car the twentieth from the top; and the first time of the heaps, he says it is in the third heap; you th at the table in the perspective, and you see that figure is two; you, therefore, put that heap in the of the pack. The second and third times, you manner put the heap in which he says it is, at b the number each time being three. Then lookin pack with your glass, as if to discover which the c you lay the cards down one by one, and the tw will be the card fixed on.

The Card in the Ring.

Get a ring made of any metal, in which is set transparent stone or piece of glass, to the bottom o is fastened a small piece of black silk; under the to be the figure of a small card; and the silk mus constructed, that it may be either drawn aside or by turning the stone round.

You then cause a person to draw the same sort as that at the bottom of the ring; and tell him it in the candle. Now the ring being so construct the silk conceals the card underneath it, you firs him the ring, that he may see it is not there, and t you will make it appear; then rubbing the ashes card on the ring, you manage to turn the stone dexterously round, and exhibit to him the small the bottom.

The Card in the Mirror.

IDE a mirror, either round or oval, the frame of
nust be at least as wide as a card, and the glass
: wider than the distance between the frame, by at
e width of a card. The glass in the middle must
e to move in two grooves, and so much of the
ver must be scraped off, as is equal to the size of
on card. You then paste over the part where the
ver is rubbed off, a piece of pasteboard, on which
d that must exactly fit the space, which must at
placed behind the frame.
his mirror against a partition, through which two
are to go, by which an assistant in an adjoining
n easily move the glass in the grooves, and make
d appear or disappear at pleasure. Or it may be
thout an assistant, if a table be placed against the
n, and a string from the glass be made to pass
a leg of it, and communicate with a small trigger,
ou may easily push down with your foot, and at the
ne wiping the glass with your handkerchief, under
tence that the card may appear more conspicuous,
will also serve most effectually to disguise the
n.
g every thing thus arranged, you contrive to make
n draw the same sort of card as that fixed to the
if you do not succeed in this with a stranger, make
etence for shuffling the cards again, and present
k to a confederate, who, of course, will draw the
u wish, and who is to shew it to two or three
next him, under the pretence that it might slip
ory. This card you place in the middle of the
hen *make the pass*, and bring it to the bottom.
he person to look for his card in the mirror, when
federate behind the partition is to draw it slowly
; or if you perform the operation yourself, press
ger with your foot, and the card will appear as if
between the glass and the quicksilver. While the
drawing forward, you slide off the card from the
of the pack, and convey it away.

The Card in the Opera Glass.

Procure an opera glass, two inches and a half long the tube to be made of ivory, so thin that it may appea transparent. Place it in a magnifying glass, of such power, and at such a distance, that a card three quarter of an inch long, may appear like a common-sized card At the bottom of the tube lay a circle of black pasteboard to which fasten a small card, with the pipes, or figures, o both sides, and in such a manner, that by turning the tube either side of the glass may be visible.

You then offer two cards to two persons similar to th double card in the glass. You put them in the pack again or convey them in your pocket; and after a few flourishin motions, you tell the persons you have conveyed the cards into the glass; then you shew each person his car in the glass, by turning it in the proper position.

You may easily induce the parties to draw the two card you wish, by placing them first on the top of the pack, an then, by making the pass, bringing them to the middl When you can make the pass in a dexterous manner, it preferable to the long card, which obliges the operato to change the pack frequently, as, if the same card is a ways drawn, it may excite suspicion.

To separate the Two Colours of a Pack of a Cards One Cut.

To perform this amusement all the cards of one colo must be cut something narrower at one end than the othe You show the cards, and give them to any one that he m shuffle them, then holding them between your hands, o hand being at each extremity, with one motion you sep rate the hearts and diamonds from the spades and clubs

The Metamorphosed Cards.

In the middle of a pack place a card that is somethi wider than the rest, which we will suppose to be the kn of spades, under which place the seven of diamonds, a

r that the ten of clubs. On the top of the pack put similar to these, and others on which are painted ent objects, *viz.*

First card	A bird
Second	A seven of diamonds
Third	A flower
Fourth	Another seven of diamonds
Fifth	A bird
Sixth	A ten of clubs
Seventh	A flower
Eighth	Another ten of clubs

e seven or eight indifferent cards, the knave of s, which is the wide card, the seven of diamonds, n of clubs, and the rest any indifferent cards.

o persons are to draw the two cards that are under ide card, which are the seven of diamonds and the clubs. You then take the pack in your left hand, pen it at the wide end, as you open a book, and tell erson who drew the seven of diamonds to place it in pening. You then blow on the cards, and, without g them, instantly bring the card which is at top, and ich a bird is painted, over that seven of diamonds. this dexterously, you must wet the middle finger of left hand, with which you are to bring the card to iddle of the pack. You then bid the person look at rd, and when he has remarked the change, to place re it was before. Then blow on the cards a second and bringing the seven of diamonds, which is at the the pack, to the opening, you bid him to look at his again, when he will see it is that which he drew nay do the same with all the other painted cards, with the same person, or with him who drew the clubs.

whole artifice consists in bringing the cards at the the pack to the opening in the middle, by the wet , which requires no great practice. Observe, not to pack go out of your hands.

To Discover the Card which is drawn, by the Thro Die.

PREPARE a pack of cards, in which there are o sorts of cards. Dispose these cards in such a mann each of the six different cards shall follow each oth let the last of each suite be a long card. The cards thus disposed, it follows, that if you divide them i parcels, by cutting at each of the long cards, those will all consist of similar cards.

Let a person draw a card from the pack, and l replace it in the parcel from whence it was dra dexterously offering that part. Cut the cards times, so that a long card be always at bottom. the cards in this manner into six heaps, and giving to the person who drew the card, tell him that th he throws shall indicate the parcel in which is the c drew; then take up that parcel and show him the c

To tell the Number of the Cards by their Weigh

TAKE a parcel of cards, suppose forty, among insert two long cards; let the first be, for exampl fifteenth, and the other the twenty-sixth from th Seem to shuffle the cards, and then cutting them first long card, poise those you have cut off in yo hand, and say, "there should be here fifteen c Cut them again at the second long card, and say, " are here only eleven cards." Then poising the re der, you say, "here are fourteen cards."

The Four inseparable Kings.

TAKE the four kings, and behind the last of them two other cards, so that they may not be seen. spread open the four kings to the company, and p six cards at the bottom of the pack. Draw one of the and put it at the top of the pack. Draw one of th cards at the bottom and put it towards the middle. the other, and put it at some distance from the last

en shew that there remains a king at bottom. Then any one cut the cards, and as there remained three ngs at bottom, they will then be altogether in the mid- of the pack.

change the Cards which several Persons have drawn from the Pack.

On the top of the pack put any card you please, suppose queen of clubs; make the pass, bring that card to middle of the pack, and offer it to a person to draw. en, by cutting the cards, bring the queen again to the ddle of the pack. Make the pass a second time, ng it to the top, and shuffle the cards without displacing se on the top. Make the pass a third time, bring o the middle of the pack, and offer it to a second per- i to draw, who must be at a proper distance from the t person, that he may not perceive it is the same d. After the like manner let five persons draw the e card.

huffle the pack without losing sight of the queen of bs, and laying down four other cards with the queen, each person if he see his card there? They will all ly "yes," as they all drew the queen of clubs. Place r of those cards to the pack, and drawing the queen rately away, you approach the first person, and shewing that card, so that the others cannot see it, ask if that his card; then putting it on the top of the pack, blow on r give it a stroke with your hand, and shew it in the e manner to the second person, and so of the rest.

The Card discovered under the Handkerchief.

er a person draw any card from the rest, and put it in middle of the pack; you make the pass at that place, l the card will consequently be at top; then placing the k on the table, cover it with a handkerchief, and put- your hand under it, take off the top card, and after ming to search among the cards for some time, draw it

This amusement may be performed by putting th in another person's pocket, after the pass is mad veral cards may also be drawn and placed togethe middle of the pack, and the pass then made.

The Convertible Aces.

On the ace of spades fix, with soap, a heart, the ace of hearts a spade, in such a manner that t easily slip off.

Show these two aces to the company; then tak ace of spades, you desire a person to put his fo it, as you place it on the ground, draw av spade. In like manner you place the seeming hearts under the foot of another person. You th mand the two cards to change their places; a they obey your command, the two persons, on tak their cards, will have ocular demonstration.

A deception similar to this is sometimes p with one card, suppose the ace of spades, over heart is pasted slightly. After shewing a pe card, you let him hold one end of it, and you l other and while you amuse him with discourse, y off the heart, Then laying the card on the table, him cover it with his hand; you then knock un table, and command the heart to turn into th spades.

To tell the Card that a Person has touched with his

This amusement is to be performed by conf You previously agree with your confederate o signs, by which he is to denote the suite, and the p card of each suite; thus: if he touch the first l his coat, it signifies an ace; if the second, a l and then again, if he take out his handkerchief, it the suite to be hearts; if he take snuff,—diamo These preliminaries being settled, you give the p person who is near your confederate, and tell separate any one card from the rest, while you ar

and draw his finger once over it. He is then to return you the pack, and while you are shuffling the cards, you carefully note the signals made by your confederate; then turning the cards over one by one, you directly fix on the card he touched.

The Card in the Pocket Book.

A CONFEDERATE is previously to know the card you have taken from the pack and put into your pocket book. You then present the pack to him, and desire him to fix on a card, (which we will suppose to be the queen of diamonds,) and place the pack on the table. You then ask him the name of the card, and when he says the queen of diamonds, you ask him if he be not mistaken, and if he be sure that the card is in the pack; when he replies in the affirmative, you say, "It might be there when you looked over the cards, but I believe it is now in my pocket;" then desire a third person to put his hand in your pocket, and take out your book, and when it is opened the card will appear.

The Card in the Egg.

TAKE a card, the same as your long card, and rolling it up very close, put it in an egg, by making a hole as small as possible, and which you are to fill up carefully with white wax. You then offer the long card to be drawn, and when it is replaced in the pack you shuffle the cards several times, giving the egg to the person who drew the card, and while he is breaking it, you privately withdraw the long card, that it may appear upon examining the cards, to have gone from the pack into the egg. This may be rendered more surprising by having several eggs, in each of which is placed a card of the same sort, and then giving the person the liberty to choose which egg he thinks fit.

This deception may be still further diversified, by having, as most public performers have, a confederate, who is previously to know the egg in which the card is placed; for you may then break the other eggs, and

shew that the only one that contains a card is th
which you directed it to be.

The Card discovered by the Touch or Smell.

You offer the long card, or any other that you k
and as the person who has drawn it holds it in his h
you pretend to feel the pips or figure on the under
by your fore-finger; or you sagaciously smell to it,
then pronounce what card it is.

If it be the long card, you may give the pack t
person who drew it, and leave him at liberty either t
place it or not. Then taking the pack, you feel ir
diately whether it be there or not, and shuffling the
in a careless manner, without looking at them, you
nounce accordingly.

The inverted Cards.

Prepare a pack of cards, by cutting one end of
about one-tenth of an inch narrower than the o
then offer the pack to any one, that he may dr
card; place the pack on the table, and observe care
if he turn the card while he is looking at it: if h
not, when you take the pack from the table, you
the other end of it for him to insert that card; but
turn the card, you then offer him the same end o
pack. You afterwards offer the cards to a secon
third person, for them to draw or replace a card ir
same manner. You then let any one shuffle the cards,
taking them again into your own hand, as you turn
up one by one, you easily perceive by the touch w
those cards are that have been inverted, and laying
first of them down on the table, you ask the pers
that card be his, if he say *no*, you ask the same of th
cond person, and if he say *no*, you tell the third pers
is his card; and so of the second and third cards.
should lay the pack on the table after each person
drawn his card, and turn it dexterously in taking it
when it is to be turned, that the experiment may not
pear to depend on the cards being inverted.

The Transmutable Cards.

nmon pack of cards let the ace of hearts and nine be something larger than the rest. With the mmon draw over the ace of hearts a spade, large ɔ cover it entirely, and on each side draw four les.

: the pack to two persons, so adroitly, that one of l draw the ace of hearts, and the other the nine and tell him who draws the latter, to burn it on dish. You then take the ashes of that card, put a small metal box, and give it to him that has the arts, that he may himself put that card into the asten it. Then put the box for a short time on dish, and let the person who put the card in it, ; and take out the card, which he will see is nto the nine of spades.

The Convertible Cards.

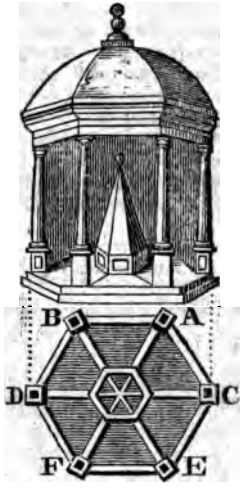
orm this amusement you must observe, that there l letters which may be changed into others, with- ɔpearance of the alteration, as the *a* into *d*, the *c* *d*, *g*, *o*, or *q*; the *i* into *b*, *d*, or *l*; the *l* into *t*; *a*, *d*, *g*, or *q*; the *v* into *y*, &c.

parcel of cards, suppose twenty, and on one of e with the juice of lemon or onion, or vitriol and : word *law*, (these letters should not be joined ;) : other, with the same ink, the words *old woman*; ing them to the fire they both become visible. will observe, that by altering the *a* in the word . and adding *o* before the *l*, and *oman* after the *w*, s *old woman*. Therefore you make those altera- the invisible ink, and let it remain so. On the :. cards you write any words you think fit.

: the cards in such manner to two persons, that one hall draw the word *law*, and the other the words . You then tell the person who drew the word it shall disappear, and the words on the other be written in its place; and that you may not e cards; desire each of the parties to write his iis card. Then putting the cards together, and

holding them before the fire, as if to draw the names, written the word *law* will presently change into *old won*

The Enchanted Palace.



On the six-sided plane, A B C D E F, draw six se diameters; and on each of these place perpendicularly plane mirrors which must join exactly at the centre, which placed back to back, must be as thin as possi Decorate the exterior boundary of this piece, (which i the extremity of the angles of the hexagon) with six lumns, that at the same time serve to support the mir by grooves formed on their inner sides. Add to these lums their entablatures, and cover the edifice in what manner you please. In each one of these six triang spaces, contained between two mirrors, place little fig of pasteboard, in relief, representing such objects as w

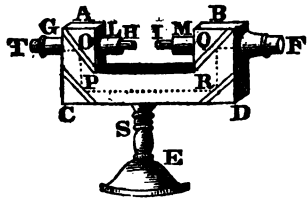
in an hexagonal form will produce an agreeable ef-

To these add small figures of enamel, and take par-
ar care to conceal by some object that has no relation
e subject, the place where the mirrors join, which, as
re observed, all meet in the common centre.

hen you look into any one of the six openings of this
ce, the objects there contained, being reflected six
s, will seem entirely to fill up the whole of the buil-
. This illusion will appear very remarkable, especi-
if the objects chosen are properly adapted to the ef-
which the mirrors are intended to produce.

you place between two of these mirrors part of a
fication, as a curtain, and two demi-bastions, you will
n entire citadel with six bastions; or if you place part
ball-room, ornamented with chandeliers and figures,
hose objects being here multiplied, will afford a very
sing prospect.

Opaque Bodies seemingly transparent.



Within the case A B C D, place your mirrors O P Q R,
disposed, that they may each make an angle of 45
rees, that is that they may be half way inclined from
perpendicular, as in the figure. In each of the two
remities A B, make a circular overture, in one of which
the tube G I., in the other the tube M F, and observe
: in each of these is to be inserted another tube as H
I. [*Observe.* These four tubes must terminate in the
stance of the case, and not enter the inside, that they
not hinder the effect of the mirrors. The four-fold

reflection of the rays of light from the mirrors, darkens i some degree the brightness of the object; some light i also lost by the magnifying power of the perspective. I therefore, instead of the object-glass at G, and concav eye-glass at F, plain glasses were substituted, the magni fying power of the perspective will be taken away, and th object appear brighter.]

Furnish the first of these tubes with an object-glass at G, and a concave eye-glass at F. You are to observe, that in regulating the focus of these glasses with regard to the length of the tube, you are to suppose it equal to the line G, or visual pointed ray, which entering at the aperture G is reflected by the four mirrors, and goes out at the other aperture F, where the eye-glass is placed. Put any glass you please into the two ends of the moveable tubes H and L; and lastly, place the machine on a stand E, moveable at the point S, that it may be elevated or lowered at pleasure.

When the eye is placed at F and you look through the tube, the rays of light that proceed from the object T passing through the glass G are successively reflected by the mirrors O P Q and R to the eye at F, and there point the object T in its proper situation, and these rays appear to proceed directly from that object.

The two moveable tubes H and I, at the extremity of which a glass is placed, serve only to disguise the illusion, for they have no communication with the interior of the machine. This instrument being moveable on the stand E, may be directed to any object; and if furnished with proper glasses, will answer the purpose of a common perspective.

The two moveable tubes, H and I, being brought together, the machine is directed towards any object, and desiring a person to look at the end F, you ask him if he sees that object distinctly. You then separate the two moveable tubes, and leaving a space between them sufficiently wide to place your hand or any other solid body, you tell him that the machine has the power of making objects visible through the most opaque body; and as a proof, you desire him to look at the same object, when to his great surprise he will see it as distinctly as if no solid body *interposed*.

This experiment is the more extraordinary as it is very difficult to conceive how the effect is produced: the two arms of the case appearing to be made for the purpose of supporting the perspective glass; and to whatever object it be directed, the effect is still the same.

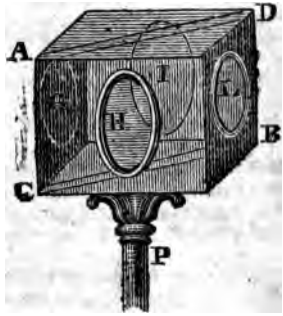
The Deforming Mirrors.

If a person look in a concave mirror placed perpendicular to another, (that is, supposing one mirror be laid on the floor, and the other attached to the ceiling,) his face will appear entirely deformed. If the mirror be a little inclined, so as to make an angle of 80 degrees, (that is, one-ninth part from the perpendicular,) he will then see all the parts of his face, except the nose and forehead. If it be inclined to 60 degrees, (that is one-third part,) he will appear with three noses and six eyes; in short, the apparent deformity will vary at each degree of inclination, and when the glass comes to 45 degrees, (that is, half-way down) the face will vanish. If, instead of placing the two mirrors in this situation, they are so disposed that their junction may be vertical, then different inclinations will produce other effects, as the situation of the object relative is quite different.

The Magic Tube.

Procure a small tube of glass, whose canal is extremely narrow, and open at both ends; let one end of it be plunged in water, and the water within the tube will rise to a considerable height above the external surface: or if two or more tubes be immerged in the same fluid, the one with a narrow canal, and the other wider, the water will ascend higher in the former than the latter.

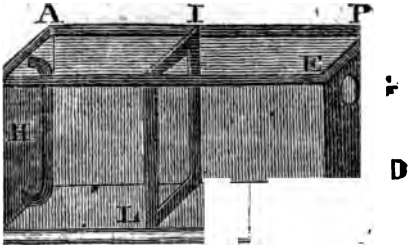
The Magician's Mirror.



Construct a box of wood, of a cubical shape, A
of about 15 inches every way. Let it be fixed
pedestal P, at the usual height of a man's head.
side of this box let there be an opening, of an ov
ten inches high and seven wide. In this box pla
mirrors, A D, with their backs against each othe
them cross the box in a diagonal line, and in a
position. Decorate the opening in the sides of
with four oval frames and transparent glasses, an
each with a curtain so contrived as to all draw up t

Place four persons in front of the four sides,
equal distances from the box, and then draw them
they may see themselves in the mirrors, when
them, instead of his own figure, will see that of
son next to him, but who will appear to him to b
on the opposite side. Their confusion will be th
er, as it will be very difficult, if not impossible for
discover the mirrors concealed in the box. The
this phenomenon is evident; for though the rays
may be turned aside by a mirror, yet they alway
to proceed in right lines.

The Perspective Mirror.



ɔɛ a box, A B C D, of about two feet long, 15 ıde, and 12 inches high. At the end A C, place ɛ mirror, the focus of whose parallel rays is 18 ɔm the reflecting surface. At I L place a paste-acked, in which a hole is cut, sufficiently large to .e mirror H the object placed at B E F D. Co-ɔp of the box, from A to I close, that the mirror ıe entirely darkened. The other part I B must ed with glass, under which is placed a gauze or ıer, to prevent the inside from being seen. Make ure at G, near the top of the side E B, beneath ı the inside, place in succession paintings of vis-scapes, figures, &c. so that they may be in front rror H. Let the box be so placed that the ob-y be strongly illuminated by the sun, or by wax aced under the enclosed part of the box A I. simple construction, the objects placed at G D hrown into their natural perspective, and if the be properly chosen and well executed, the ap-: will be both wonderful and pleasing.

Gunpowder exploded by Reflection.

two concave mirrors at about 12 or 15 feet dis-m each other, and let the axis of each be in the :. In the focus of one of them place a live coal,

and in the focus of the other place some gunpowder. With a pair of double bellows, which make a continual blast, keep constantly blowing the coal, and notwithstanding the distance between them, the powder will presently take fire.

The Igniting Mirrors.

The rays of a luminous body placed in the focus of a concave mirror, being reflected in parallel lines, and a second mirror being placed diametrically opposite to the first, will set fire to a combustible body, by collecting those rays into its focus.

The Armed Apparition.

If a person with a drawn sword place himself before a large concave mirror, but further from it than its focus, he will see an inverted image of himself in the air, between him and the mirror, of a less size than himself. If he steadily present the sword towards the centre of the mirror, an image of the sword will come out from it, point to point, as if to fence with him; and by his pushing the sword nearer, the image will appear to come nearer to him and almost to touch his breast. If the mirror be turned 45 degrees or one-eighth round, the reflected image will go out perpendicular to the direction of the sword presented, and apparently come to another person placed in the direction of the motion of the image, who, if he be unacquainted with the experiment, and does not see the original sword, will be much surprised and alarmed.

The Phantom.

You inform a person that at a certain hour, and in a certain place, he shall see the apparition of a deceased friend, (whose portrait you possess.) In order to produce this phantom there must be a door which opens into an apartment to which there is a considerable descent. Under that door you are to place the portrait, which must be inverted and strongly illuminated, that it may be brightly

reflected by the mirror, which must be large and well polished. Then having introduced the incredulous spectator at another door, and placed him in the proper point of view, you suddenly throw open the door, when to his great surprise he will view the apparition of his friend.

The Distorting Mirror.

Opticians sometimes grind a glass mirror concave in one direction only, or longitudinally; it is in fact a concave portion of a cylinder, the breadth of which may be considered that of the mirror. A person looking at his face in this mirror, in the direction of its concavity, will see it curiously distorted in a very lengthened appearance; and by turning the cylindrical mirror a quarter round, his visage will appear distorted another way, by an apparent increase in width only. If in a very near situation before it, you put your finger on the right hand side of your nose, it will appear the same in the mirror; but if in a distant situation, somewhat beyond the centre of concavity, you again look at your face in the mirror, your finger will appear to be removed to the other side of your nose.

Water colder than Ice.

Put a lump of ice into an equal quantity of water, heated to 176 degrees, the result will be, that the fluid will be no hotter than water just beginning to freeze; but if a little sea salt be added to the water, and it be heated only to 166 or 170, a fluid will be produced *colder than the ice was at first.*

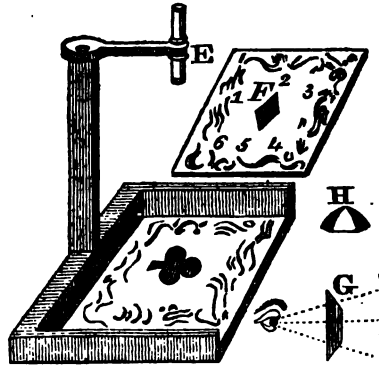
Exploding Salt.

If a small quantity of powdered charcoal and hyperoxymuriate of potash be rubbed together in a mortar, an explosion will be produced, and the charcoal inflamed. Three-parts of this salt, and one of sulphur, rubbed together in a mortar, produce a violent detonation. If struck

with a hammer on an anvil, there is an explosion like the report of a pistol.

When concentrated sulphuric acid is poured upon this salt, there is a considerable explosion; it is thrown about to a great distance, sometimes with a red flame; and there is exhaled a brown vapour, accompanied with a strong odour.

Dioptrical Paradox.



Construct a machine like the above figure. Its effect will be, that a print or an ornamented drawing, with any object, such as an ace of diamonds, &c. in the centre F, will be seen as an ace of clubs when placed in the machine, and viewed through a single plain glass only, contained in the tube E. The glass in the tube F, which produces this surprising change, is somewhat on the principle of the common multiplying glass, as represented at G, which, by the number of its inclined surfaces, and from the refractive power of the rays proceeding from the objects placed before it, shows it in a multiplied state. The only difference is, that the sides of this glass are flat, and diverge upwa

from the base to a point in the axis of the glass like a cone: it has six sides, and each side from its angular position to the eye, has the property of refracting from the border of the print F, such a portion of it (designedly placed there) as will make a part in the composition of the figure to be represented; for the hexagonal and conical figure of this glass prevents any part of the ace of diamonds being seen; consequently the ace of clubs being previously and mechanically drawn in the circle of refraction in six different parts of the border, at 1, 2, 3, 4, 5, 6, and artfully disguised in the ornamental border, by blending them with it, the glass in the tube at E will change the appearance of the ace of diamonds, F, into the ace of clubs, G. In the same manner many other prints undergo similar changes, according to the will of an ingenious draughtsman who may design them. The figure of the glass is shown at H.

To show the Spots in the Sun's Disk, by its Image in the Camera Obscura.

Put the object glass of a ten or twelve feet telescope into the scioptric ball, and turn it about till it be directly opposite the sun. Then place the pasteboard mentioned in page 16, in the focus of the lens, and you will see a clear bright image of the sun, of about an inch diameter, in which the spots on the sun's surface will be exactly described.

As this image is too bright to be seen with pleasure by the naked eye, you may view it through a lens whose focus is at six or eight inches distance, which, while it prevents the light from being offensive, will, by magnifying both the image and the spot, make them appear to greater advantage.

The Diagonal Opera Glass.

By the diagonal position of a plane mirror, a curious opera glass is constructed, by which any person may be viewed in a theatre or public company without knowing it.

It consists only in placing a concave glass near the plane mirror, in the end of a short round tube, and a convex glass in a hole in the side of the tube, then holding the end of the tube with the glass to the eye, all objects next to the hole in the side will be reflected so as to appear in a direct line forward, or in a position at right angles to the person's situation who is looked at. Plane glasses, instead of a convex and concave, may be used, but in this case the size of the object will not be increased, but it will appear brighter.

To observe an Eclipse of the Sun, without Injury to the Eye.

Take a burning glass, or spectacle glass, that magnifies very much; hold it before a book or pasteboard, twice the distance of its focus, and you will see the round body of the sun, and the manner in which the moon passes between the glass and the sun, during the whole eclipse.

The Burnt Writing restored.

Cover the outside of a small memorandum book with black paper, and in one of its inside covers make a flap, to open secretly, and observe there must be nothing over the flap but the black paper that covers the book.

Mix soot with black or brown soap, with which rub the side of the black paper next the flap; then wipe it clean, so that a white paper pressed against it will not receive any mark.

Provide a black lead pencil that will not mark without pressing hard on the paper. Have likewise a small box, about the size of a memorandum book, and that opens on both sides, but on one of them by a private method. Give a person the pencil and a slip of thin paper, on which he is to write what he thinks proper; you present him the memorandum book at the same time, that he may not write on the bare board. You tell him to keep what he writes to himself and direct him to burn it on an iron plate

ıid on a chafing-dish of coals, and give you the ashes. You ıen go into another room to fetch your magic box, before escribed, and take with you the memorandum book.

Having previously placed a paper under the flap in the over of the book, when he presses hard with the pencil,) write on his paper, every stroke, by means of the stuff ubbed on the black paper, will appear on that under the ap. You therefore take it out, and put it into one side of he box.

You then return to the other room, and taking a slip of lank paper, you put it into the other side of the box, trewing the ashes of the burnt paper over it. Then shaking the box for a few moments, and at the same time turning it dexterously over, you open the other side, and shew he person the paper you first put in, the writing on which ıe will readily acknowledge to be his.

If there be a press or cupboard that communicates with he next room, you need only put the book in the press, ınd your assistant will open it, and put the paper in the ox, which you presently after take out, and perform the est of the amusement as before.

There may likewise be a flap on the other cover of the ook, and you may rub the paper against that with red ead. In this case you give the person the choice of writıg either with a black or red pencil; and present him the roper side of the book accordingly.

The Opaque Box made transparent.

Make a box of three or four inches long, and two or hree wide, and have a sort of perspective glass, the botom of which is the same size with the box, and slides out, hat you may privately place a paper on it. The sides of his perspective are to be of glass, covered on the inside rith fine paper.

Let a person write on a slip of paper, putting your ıemorandum book under it as in the last amusement; then ive him the little box, and let him put what he has written ıto it. In the mean time you put the memorandum book ıto the press, where the perspective is already placed,

Your assistant then takes the paper out of the book, and puts it at the bottom of the perspective; which you presently take out of the press, and direct the person to put the little box that contains his paper under it. You then look in at the top of the perspective, and feigning to see through the top of the box, you read what is written on the paper at the bottom of the perspective.

With this perspective box you may perform another amusement, which is, by having in a bag twelve or more ivory counters, numbered, which you shew to the company, that they may see all the numbers are different. You tell a person to draw any one of them, and keep it close in his hand. You then put the bag in the press, when your assistant examines the counters, and sees which is wanting, and puts another of the same number at the bottom of the perspective, which you then take out, and placing the person's hand close to it, look in at the top, and pretending to see through his hand, you name the number on the counter in it.

The Transposable Pieces.

Take two guineas and two shillings, and grind part of them away, on one side only, so that they may be but half the common thickness; and observe, that they must be quite thin at the edge; then rivet a guinea and a shilling together. Lay one of these double pieces, with the shilling upwards, on the palm of your hand, at the bottom of your three first fingers, and lay the other piece with the guinea upwards in the like manner, in the other hand. Let the company take notice in which hand is the guinea, and in which is the shilling. Then as you shut your hands, you naturally turn the pieces over, and when you open them again, the shilling and the guinea will appear to have changed their places.

The Penetrative Guinea.

Provide a round tin box, of the size of a large snuff box, and in this, place eight other boxes, which will go easily into each other, and let the least of them be of a size to

hold a guinea. Each of these boxes should shut with a hinge, and to the least of them there must be a small lock, that is fastened with a spring, but cannot be opened without a key;—observe that all these boxes must be shut so freely, that they may be closed all at once. Place these boxes in each other, with their tops open, in the drawer of the table on which you make your experiments; or, if you please, in your pocket, in such manner that they cannot be displaced.

Then ask a person to lend you a new guinea, and desire him to mark it that it may not be changed. You take this piece in one hand, and in the other you have another of the same appearance, and putting you hand into the drawer, you slip the piece that is marked into the least box, and shutting them all at once, you take them out; then shewing the piece you have in your hand, and which the company suppose to be the same that was marked, you pretend to make it pass through the box, and dexterously convey it away.

You then present the box, for the spectators do not yet know that there are more than one, to any person in company, who, when he opens it, finds another, and another, till he comes to the last, but that he cannot open without the key, which you then give him, and retiring to a distant part of the room, you tell him to take out the guinea himself, and see if it be that which he marked.

This amusemeet may be made more surprising, by putting the key into a snuff-box of one of the company, which you may do by asking him for a pinch of his snuff, and at the same time conceal the key, which must be very small among the snuff; and when the person, who is to open the box, asks for the key, you tell him that one of the company has it in his snuff box. This part of the amusement may likewise be performed by means of a confederate.

To make Pictures of Birds with their natural Feathers.

First take thin board or pannel, of deal or wainscot, *well seasoned that* it may not shrink; then paste white

paper smoothly on it, and let it dry; if the colour of the wood shew through, paste a second paper over it. When the paper is dry, get ready any bird that you would represent, and draw the outline as exact as you can on the papered pannel. You then paint the ground-work, stump of a tree, the bill and legs, their proper colour, with water-colours, leaving the body to be covered with its own natural feathers. In the space you have left for the body, you lay on very thick gum water, letting each coat dry before you lay on another, and so continuing till the gum is as thick as a shilling. Then take the feathers of the bird; and as you proceed, draw a camel's hair pencil, dipped in gum-water, over the coat of gum that you have laid on the paper, that it may mare readily adhere. As you strip the bird, you must fix the feathers in their proper places on the board, and you shave the shafts or stems of the larger feathers, that they may lay flat. The most ready way to perform the operation, is to provide yourself with a pair of steel pliars to take up and lay on the feathers with. You should prepare some small leaden weights to lay on the feathers, that they may more readily adhere to, and lay flat on, the gum. The part where the eye is must be supplied by a small piece of paper, coloured and shaped like one, or you may, probably, be able to get a glass bead that will answer the purpose better. In order that the feathers may lay smooth and regular, when the whole is perfectly dry, lay a book, or a flat board, with a weight on it.

The Art of Bronzing.

Bronzing is that process by which figures of plaster-of-paris, wood, &c. are made to have the appearance of copper or brass. The method is as follows:

Dissolve copper filings in aqua-fortis. When the copper has impregnated the acid, pour off the solution, and put into it some pieces of iron, or iron filings. The effect of this will be to sink the powder to the bottom of the acid. Pour off the liquor, and wash the powder in successive quantities of fresh water. When the powder is dry, it is to be rubbed on the figure with a soft cloth, or piece of lea-

ther; but observe, that previously to the application of the bronze powder, a dark blackish sort of green is first to be laid on the figure; and if you wish the powder to adhere stronger, mix it with gum water, lay it on like paint, with a camel's hair brush, or previously trace the parts to be bronzed, with gold size, and when nearly dry, rub the powder over it.

Method of taking the Impression of Butterflies on Paper.

Clip the wings off the butterfly, lay them on clean, in the form of a butterfly when flying. Spread some thick clean gum-water on another piece of paper, press it on the wings, and it will take them up; lay a piece of white paper over it, and rub it gently with your finger, or the smooth handle of a knife. The bodies are to be drawn in the space which you leave between the wings.

To make Moulds of Horn.

If you wish to take the impression of any coin, medal, &c. previously anoint it with oil; then lay the horn shavings over it in its softened state. When dry, the impression will be sunk into the horn; and this will serve as a mould to re-produce, either by plaster-of-paris, putty and glue, or isinglass and ground egg-shells, the exact resemblance of the coin or medal.

To soften Horn.

To one pound of wood ashes, add two pounds of quick lime; put them into a quart of water. Let the whole boil till reduced one-third. Then dip a feather in, and if, on drawing it out, the plume should come off, it is a proof that it has boiled enough; if not, let it boil a little longer. When it is settled, filter it off, and in the liquor thus strained put in shavings of horn. Let them soak for three days; and, first anointing your hands with oil, work the horn into a mass, and print or mould it into any shape you please.

To cast Figures in Imitation of Ivory.

MAKE isinglass and strong brandy into a paste, with powder of egg-shells, very finely ground. You may give it what colour you please; but cast it warm into your mould, which you previously oil over. Leave the figure in the mould till dry, and you will find, on taking it out, that it bears a very strong resemblance to ivory.

To extract the Silver out of a Ring, that is thick gilded, so that the Gold may remain entire.

TAKE a silver ring that is thick gilded. Make a little hole through the gold into the silver; then put the ring into aqua-fortis, in a warm place: it will dissolve the silver, and the gold will remain whole.

To soften Iron or Steel.

EITHER of the following simple methods will make iron or steel as soft as lead:

1. Anoint it all over with tallow; temper it in a gentle charcoal fire, and let it cool of itself.
2. Take a little clay, cover your iron with it, temper it in a charcoal fire.
3. When the iron or steel is red hot, strew hellebore on it.
4. Quench the iron or steel in the juice or water of common beans.

To Take a Plaster-of-Paris Cast from a Person's Face.

THE person must lie on his back, and his hair be tied behind. Into each nostril put a conical piece of paper, open at each end to allow of breathing. The face is to be lightly oiled over, and plaster being properly prepared, is to be poured over the face, taking care that the eyes are shut, till it is a quarter of an inch thick. In a few minutes, the plaster may be removed. In this a mould is to be formed, from which a second cast is to be taken, that will furnish casts exactly like the original.

Curious Experiment with a Glass of Water.

SATURATE a certain quantity of water in a moderate heat, with three ounces of sugar; and when it will no longer receive that, there is still room in it for two ounces of salt of tartar, and after that for an ounce and a drachm of green vitriol, nearly six drachms of nitre, the same of salammoniac, two drachms and a scruple of alum, and a drachm and a half of borax.

To make Artificial Coruscations.

THERE is a method of producing artificial coruscations, or sparkling fiery meteors, which will be visible, not only in the dark, but at noon-day, and that from two liquors actually cold. The method is this:—Fifteen grains of solid phosphorus are to be melted in about a drachm of water: when this is cold, pour upon it two ounces of oil of vitriol; let these be shaken together in a large phial, and they will at first heat, and afterwards will throw up fiery balls in great number, which will adhere like so many stars to the sides of the glass, and continue burning a considerable time; after this, if a small quantity of oil of turpentine be poured in, without shaking the phial, the mixture will of itself take fire, and burn very furiously. The vessel should be large, and open at the top.

Another Method.

ARTFIICIAL coruscations may also be produced by means of oil of vitriol and iron, in the following manner:—Take a glass body capable of holding three quarts, put into this three ounces of oil of vitriol, and twelve ounces of water; then warming the mixture a little, throw in at several times, two ounces, or more, of clear iron filings; upon this, an ebullition and white vapours will arise; then present a lighted candle to the mouth of the vessel, and the vapour will take fire, and afford a bright fulmination or flash, like lightning. Applying the candle in this manner several times, the effect will always be the same, and sometimes the fire will fill the whole body of the glass, and even circulate to the bottom of the liquor; at others, will only reach a

little way down its neck. The great caution to be t making this experiment, is the making the vapou proper heat; for if made too cold, few vapours will and if made too hot, they will arise too fast, and wi take fire in the neck of the glass, without any rema coruscation.

To produce Fire from Cane.

The Chinese rattans, which are used, when sp making cane chairs, will, when dry, if struck again other, give fire; and is used accordingly in some pla lieu of flint and steel.

To make an Eolian Harp.

This instrument may be made by almost any carp it consists of a long narrow box of very thin deal, five or six inches deep, with a circle in the middle upper side, of an inch and a half in diameter, in wh to be drilled small holes. On this side, seven, more strings, of very fine gut, are stretched over bri each end, like the bridges of a fiddle, and screwe relaxed with screw pins. The strings must be all t one and the same note, and the instrument be pl some current of air, where the wind can pass over its with freedom. A window, of which the width is equal to the length of the harp, with the sash just r give the air admission, is a proper situation. Wl air blows upon these strings, with different deg force, it will excite different tones of sound; sometir blast brings out all the tones in full concert, and son it sinks them to the softest murmurs.

To shew the Pressure of the Atmosphere.

Invert a tall glass jar, in a dish of water, and lighted taper under it: as the taper consumes the ai jar, its pressure becomes less on the water imme under the jar; while the pressure of the atmosphere water *without* the circle of the jar remaining the san

of the water in the dish will be forced up into the jar, to supply the place of the air which the taper has consumed. Nothing but the pressure of the atmosphere could thus cause part of the water to rise within the jar, above its own level.

Subaqueous Exhalation.

Pour a little clear water into a small glass tumbler, and put one or two small pieces of phosphoret of lime into it. In a short time, flashes of fire will dart from the surface of the water, and terminate in ringlets of smoke, which will ascend in regular succession.

Remarkable properties in Certain Plants.

Plants, when forced from their natural position, are endowed with a power to restore themselves. A hop-plant, twisted round a stick, directs its course from south to west, as the sun does. Untwist it, and tie it in the opposite direction; it dies. Leave it loose in the wrong direction; it recovers its natural direction in a single night. Twist a branch of a tree so as to invert its leaves, and fix it in that position; if left in any degree loose, it untwists itself gradually, till the leaves be restored to their natural position. What better can an animal do for its welfare? A root of a tree meeting with a ditch in its progress, is laid open to the air; what follows? It alters its course like a rational being, dips into the ground, surrounds the ditch, rises on the opposite side to its wonted distance from the surface, and then proceeds in its original direction. Lay a wet sponge near a root laid open to the air; the root will direct its course to the sponge; change the place of the sponge; the root varies its direction. Thrust a pole into the ground at a moderate distance from a climbing plant; the plant directs its course to the pole, lays hold of it, and rises on its natural height. A honeysuckle proceeds in its course, till it be too long for supporting its weight, and then strengthens itself by shooting into a spiral. If it meet with another plant of the same kind, they coalesce for mutual support; the one screwing to the right, the other to the left. If a honey-

suckle twig meet with a dead branch, it screws from the right to the left. The claspers of briony shoot into a spiral, and lay hold of whatever comes in their way, for support. If, after completing a spiral of three rounds, they meet with nothing, they try again by altering their course.

Flower Curiously affected by the Sun and the Weather.

The petals of many flowers expand in the sun, but contract all night, or on the approach of rain. After the seeds are fecundated, the petals no longer contract. All the trefoils may serve as a barometer to the husbandman; they always contract their leaves on an impending storm.

Easy Method of obtaining Flowers of different Colours from the same Stem.

Scoop out the pith from a small twig of elder, and having split it lengthwise, fill each of the parts with small seeds that produce flowers of different colours, but that blossom nearly at the same time. Surround them with earth; and then tying together the two bits of wood, plant the whole in a pot filled with earth, properly prepared.

Luminous Bottle, which will shew the Hour on a Watch in the Dark.

Throw a bit of phosphorous, of the size of a pea, into a long glass phial, and pour boiling oil carefully over it, till the phial is one-third filled. The phial must be carefully corked and when used should be unstopped, to admit the external air, and closed again. The empty space of the phial will then appear luminous, and give as much light as an ordinary lamp. Each time that the light disappears, on removing the stopper it will instantly re-appear. In cold weather the bottle should be warmed in the hands before the stopper is removed. A phial thus prepared may be used every night for six months.

To make luminous Writing in the Dark.

Fix a small piece of solid phosphorus in a quill, and write with it upon paper; if the paper be carried into a dark room, the writing will appear beautifully luminous.

The Sublimated Tree.

Into a large glass jar, inverted upon a flat brick tile, and containing near its top a branch of fresh rosemary, or any other such shrub, moistened with water, introduce a flat thick piece of heated iron, on which place some gum benzoin, in gross powder. The benzoin, in consequence of the heat, will be separated, and ascend in white fumes, which will at length condense, and form a most beautiful appearance upon the leaves of the vegetable.

Easy and curious Methods of foretelling Rainy or Fine Weather.

If a line be made of good whipcord, that is well dried, and a plummet affixed to the end of it, and then hung against a wainscot, and a line drawn under it, exactly where the plummet reaches, in very moderate weather it will be found to rise above it before rain, and to sink below when the weather is likely to become fair. But the best instrument of all, is a good pair of scales in one of which let there be a brass weight of a pound, and in the other a pound of salt, or of saltpetre, well dried; a stand being placed under the scale, so as to hinder its falling too low. When it is inclined to rain, the salt will swell, and sink the scale; when the weather is growing fair, the brass weight will regain its ascendency.

Contrivance for a Watch Lamp, perfectly safe, which will shew the Hour of the Night, without any trouble to a Person lying in Bed.

It consists of a stand, with three claws; the pillar of which is made hollow, for the purpose of receiving a water

candlestick of an inch diameter. On the top of the pillar, by means of two hinges and a bolt, is fixed on a small proportionate table, a box of six sides, lined with brass, tin, or any shining metal, nine inches deep, and six inches in diameter. In the centre of one of these sides is fixed a lens, double convex, of at least three inches and a half diameter. The centre of the side directly opposite to the lens, is perforated, so as to receive the dial-plate of the watch, the body of which is confined on the outside, by means of a hollow slide. When the box is lighted by a common watch-light, the figures are magnified nearly to the size of those of an ordinary clock.

Curious Experiment with a Tulip.

The bulb of a tulip in every respect resembles buds, except in their being produced under ground, and include the leaves and flower in miniature, which are to be expanded in the ensuing spring. By cautiously cutting in the early spring, through the concentric coats of a tulip root, longitudinally from the top to the base, and taking them off successively, the whole flower of the next summer's tulip is beautifully seen by the naked eye, with its petals, pistil, and stamina.

The Travelling of Sound experimentally proved.

There is probably no substance which is not in some measure a conductor of sound; but sound is much enfeebled by passing from one medium to another. If a man, stopping one of his ears with his finger, stop the other also by pressing it against the end of a long stick, and a watch be applied to the opposite end of the stick, or a piece of timber, be it ever so long, the beating of the watch will be distinctly heard; whereas, in the usual way, it can scarcely be heard at the distance of fifteen or eighteen feet. The same effect will take place if he stop both his ears with his hands, and rest his teeth, his temple, or the gristly part of one of his ears against the end of a stick. Instead of a watch, a gentle scratch may be made at one end of a pole or rod,

he person who keeps the ear in close contact with the : end of the pole, will hear it very plainly. Thus, ons who are dull of hearing, may, by applying their ı to some part of an harpsichord, or other sounding , hear the sound much better than otherwise.

a person tie a poker, or any other piece of metal, on to niddle of a strip of flannel about a yard long, then press his thumbs or fingers the ends of the flannel into his while he swings the poker against any obstacle, as an or steel fender, he will hear a sound very like that of ge church bell.

To Produce Metallic Lead from the powder.

AKE one ounce of red lead, and half a drachm of char- in powder, incorporate them well in a mortar, and fill the bowl of a tobacco-pipe with the mixture. Sub- it to an intense heat, in a common fire, and when ed, pour it out upon a slab, and the result will be illic lead completely revived.

To diversify the Colour of Flowers.

ILL a vessel, of what size or shape you please, with good earth, which has been dried and sifted in the sun, then t in the same, a slip or branch of a plant bearing a white er, (for such only can be tinged) and use no other water vater it with, but such as is tinged with red, if you re red flowers. With blue, if blue, &c. With this ured water, water the plant twice a day, morning and ing, and remove it in the house by night, so that it k not the morning or evening dew, for those weeks. will then experience, that it will produce flowers, not ether tinctured with that colour wherewith you wa- d it, but partly with that, and partly with the natural.

How far Sound Travels in a Minute.

OWEVER it may be with the regard to the theories of d, experience has taught us, that it travels at about the

rate of 1142 feet in a second, or near thirteen miles in a minute. The method of calculating its progress is easily made known: when a gun is discharged at a distance, we see the fire long before we hear the sound; if then we know the distance of the peace, and know the time of the interval between our first seeing the fire, and then hearing the report, this will show us exactly the time the sound has been travelling to us. For instance, if the gun be discharged a mile off, the moment the flash is seen, I take a watch and count the seconds till I hear the sound, the number of seconds is the time the sound has been travelling a mile.

An easy Method of making a Rain Gauge.

A very simple rain gauge, and one which will answer all practical purposes, consists of a copper funnel, the area of whose opening is exactly ten square inches: this funnel is fixed in a bottle, and the quantity of rain caught is ascertained by multiplying the weight in ounces by 173, which gives the depth in inches and parts of an inch. In fixing these gauges, care must be taken that the rain may have free access to them: hence the tops of buildings are usually the best places. When the quantities of rain collected in them at different places are compared, the instruments ought to be fixed at the same heights above the ground at both places, because at different heights the quantities are always different even at the same place.

To make beautiful transparent-coloured Water.

The following liquors, which are coloured, being mixed produce colours very different from their own. The yellow tincture of Saffron, and the red tincture of roses, when mixed produce a green. Blue tincture of violets, and brown spirit of sulphur, produce a crimson. Red tincture of roses, and brown spirits of hartshorn make a blue. Blue tincture of violets, and blue solution of copper, give a violet colour. Blue tincture of cyanus, and blue spirit of sal-ammoniac coloured, make green. Blue solution of *Hungarian* vitriol, and brown ley of potash, make yellow.

Blue solution of Hungarian vitriol, and red tincture of roses, make black; and blue tincture of cyanus, and green solution of copper, produce red.

Curious Experiment on Rays of Light.

That the rays of light flow in all directions from different bodies, without interrupting one another, is plain, from the following experiment:—Make a little hole in a thin plate of metal, and set the plate upright on a table, facing a row of lighted candles standing near together; then place a sheet of paper or pasteboard at a little distance from the other side of the plate; and the rays of all the candles flowing through the hole, will form as many specks of light on the paper as there are candles before the plate; each speck as distinct and large as if there were only one candle to cast one speck; which shews that the rays do not obstruct each other in their motions, although they all cross in the same hole.

The Power of Water.

Let a strong small iron tube of twenty feet in height be inserted into the bung-hole of a cask, and the aperture round so strongly closed, that it shall be water tight; pour water into the cask till it is full through the pipe; also continue filling the pipe till the cask bursts, which will be when the water is within a foot of the top of the tube. In this experiment the water, on bursting the vessel, will fly about with considerable violence.

The Pressure of Water.

The pressure of water may be known to every one who will only take the trouble to look at the cock of a water-butt when turned; if the tub or cistern be full, the water runs with much greater velocity through the cock, and a vessel will be filled from it in a shorter time than when it is only half full, although the cock, in both cases, is equally replete with the fluid during the time the vessel is filling. From this also is understood, how a hole or leak, near the

keel of a ship, admits the water much quicker, and with greater violence, than one of the same size near what the mariners call the water's edge.

Refraction of Light.

In the middle of an empty basin put a piece of money, and then retire from it till the edge of the basin hides the piece from your sight; then keep your head steady, let another person fill the basin gently with water; as the water rises in the basin the money will come in view; and when of a sufficient height in the basin, the whole of the piece will be in sight.

Wonderful Nature of Lightning.

If two persons, standing in a room, looking different ways, and a loud clap of thunder, accompanied with zig-zag lightning, happen, they will both distinctly see the flash at the same time; not only the illumination, but the very form of the lightning itself, and every angle it makes in its course, will be distinctly perceptible, as though they had both looked directly at the cloud from whence it proceeded. If a person happened at that time to be looking on a book, or other object, which he held in his hand, he would distinctly see the form of the lightning between him and the object at which he looked. This property seems peculiar to lightning, as it does not apply to any other kind of fire whatever.

To shew that the White of Eggs contains an Alkali.

Add to a wine glass half full of tincture of red cabbage, a small quantity of the white of an egg, either in a liquid state, or rendered concrete by boiling. The tincture will lose its blue colour, and become changed to green, because the white of the egg contains soda.

Two inodorous Bodies become very pungent and odorous by Mixture.

When equal parts of muriate of ammonia and slaked lime, both substances destitute of odour, are intimately blended together in a mortar, a very pungent gas (ammonia) becomes evolved.

Interesting Experiment for the Microscope.

The embryo grain of wheat, at the time of blossoming, being carefully taken out of the husk, will be found to have a small downy tuft at its extremity, which, when viewed in a microscope, greatly resembles the branches of thorn; spreading archwise, in opposite directions. By expanding a few of the grains, and selecting the most perfect, a very pretty microscopic object will be obtained for preservation.

The Travelling of Light.

Light travels at the rate of an hundred and fifty thousand miles in a single second; and it is seven minutes in passing from the sun to the earth, which is nearly a distance of seventy millions of miles! Such is the rapidity with which these rays dart themselves forward, that a journey they thus perform in less than eight minutes, a ball from the mouth of a cannon would not complete in several weeks! But the minuteness of the particles of light are still several degrees beyond their velocity; and they are therefore harmless, because so very small. A ray of light is nothing more than a constant stream of minute parts, still flowing from the luminary, so inconceivably little, that a candle, in a single second of time, has been said to diffuse several hundreds of millions more particles of light, than there could be grains in the whole earth, if it were entirely one heap of sand. The sun furnishes them, and the stars also, without appearing in the least to consume, by granting us the supply. Its light is diffused in a wide sphere, and seems inexhaustible.

Calculation of the Mass of Water contained in the Sea.

If we would have an idea of the enormous quantity of water which the sea contains, let us suppose a common and general depth of the ocean; by computing it at only 200 fathoms, or the tenth part of a mile, we shall see that there is sufficient water to cover the whole globe to the height of 503 feet of water; and if we were to reduce this water into one mass, we should find that it forms a globe of more than sixty miles diameter.

Different Degrees of Heat imbibed from the Sun's Rays Cloths of different Colours.

Walk but a quarter of an hour in your garden, when the sun shines, with a part of your dress white, and a part black; then apply your hand to them alternately, and you will find a very great difference in their warmth. The black will be quite hot to the touch, and the white still cool.

Try to fire paper with a burning-glass: if it be white, you will not easily burn it; but if you bring the focus to a black spot, or upon letters, written or printed, the paper will immediately be on fire under the letters.

Thus, fullers and dyers find black cloths of equal thickness with white ones, and hung out equally wet, dry in the sun much sooner than the white, being more readily heated by the sun's rays. It is the same before a fire, the heat of which sooner penetrates black stockings than white ones, and so is apt sooner to burn a man's shins. Also beer much sooner warms in a black mug set before the fire, than a white one, or in a bright silver tankard. Take a number of little square pieces of cloth from a tailor's pattern card, of various colours; say black, deep blue, lighter blue, green, purple, red, yellow, white, and other colours, or shades of colours; lay them all out upon the snow in a bright sun-shiny morning; in a few hours, the black being warmed most by the sun, will be sunk so low as to be below the stroke of the sun's rays; the dark blue almost as low: the lighter blue not quite so much as the dark; the other colours less, as they are lighter; and the quite white remain on the surface of the snow, as it will not have entered it at all.

Alternate Illusion.

WITH a convex lens of about an inch focus, look attentively at a silver seal, on which a cypher is engraved. It will at first appear cut in, as to the naked eye; but if you continue to observe it some time, without changing your situation, it will seem to be in relief, and the lights and shades will appear the same as they did before. If you regard it with the same attention still longer, it will again appear to be engraved: and so on alternately.

If you look off the seal for a few moments, when you view it again, instead of seeing it, as at first, engraved, it will appear in relief.

If while you are turned towards the light, you suddenly incline the seal, while you continue to regard it, those parts that seemed to be engraved will immediately appear in relief: and if, when you are regarding these seemingly prominent parts, you turn yourself so that the light may fall on the right hand, you will see the shadows on the same side from whence the light comes, which will apear not a little extraordinary. In like manner the shadows will appear on the left, if the light fall on that side. If instead of a seal you look at a piece of money, these alterations will not be visible, in whatever situation you place yourself.

Alarum.

AGAINST the wall of a room, near the ceiling, fix a wheel of twelve or eighteen inches diameter; on the rim of which place a number of bells in tune, and if you please, of different sizes. To the axis of this wheel there should be fixed a fly to regulate its motion; and round the circumference there must be wound a rope, to the end of which is hung a weight.

Near to the wheel let a stand be fixed, on which is an upright piece that holds a balance or moveable lever, on one end of which rests the weight just mentioned, and to the other end must hang an inverted hollow cone, or funnel, the aperture of which is very small. This cone *must be graduated* on the inside, that the sand put in may *answer to the* number of hours it is to run. Against the

upright piece, on the side next the cone, there must be fixed a check, to prevent it from descending. This stand together with the wheel, may be inclosed in a case and so contrived, as to be moved from one room to another with very little trouble.

It is evident, from the construction of this machine, that when a certain quantity of the sand is run out, the weight will descend, and put the wheel in motion, which motion will continue till the weight comes to the ground. If the wheel be required to continue longer in motion, two or more pullies may be added, over which the rope may run.

Musical Cascade.

Where there is a natural cascade, near the lower stream but not in it, let there be placed a large wheel, equal to the breadth of the cascade; the diameter of this wheel, for about a foot from each end, must be much less than that of the middle part; and all the water from the cascade must be made to fall on the ends. The water that falls on the wheel may pass through pipes, so that part of it may be made occasionallyto pass over or fall short of the wheel, as you would have the time of the music quicker or slower. The remaining part of the wheel, which is to be kept free from the water, must consist of bars, on which are placed stops that strike against the bells: these stops must likewise be moveable. It is evident, from the construction of this machine. that the water falling on the floats at the end of the wheel, will make the stops, which are adapted to different tunes, strike the notes of those tunes on the respective bells. Two or three sets of bells may here be placed on the same line, when the cascade is sufficiently wide.

When there is not a natural cascade, one may be artificialy constructed, by raising part of the ground, wherever there is a descent of water: whether it be a stream that supplies a reservoir or fountain, or serves domestic uses; or if it be refuse water that has already served some other purpose.

Writing on Glass by the Rays of the Sun.

ssolve chalk in aqua-fortis to the consistence of and add to that a strong solution of silver. Keep iquor in a glass decanter well stopped. Then cut rom a paper the letters you would have appear, and the paper on the decanter, which you are to place sun, in such a manner that its rays may pass through paces cut out of the paper, and fall on the surface of quor. The part of the glass through which the rays will turn black, and that under the paper will remain . You must observe not to move the bottle during ime of the operation.

To produce the Appearance of a Flower from its Ashes.

ke a tin box, with a cover that takes off. Let this e supported by a pedestal of the same metal, and on a there is a little door. In the front of this box is to glass.

a groove, at a small distance from this glass, place ible glass, made in the same manner as described in , (*Magic Picture.*) Between the front and back es place a small upright tin tube, supported by a piece. Let there be also a small chafing-dish placed pedestal. The box is to be open behind. You pri- y place a flower in the tube, but not so near the front as to be in the least degree visible, and presenting hat resembles it to any person, desire him to burn it e coals in the chafing-dish.

u then strew some powder over the coals, which may pposed to aid the ashes in producing the flower; and he chafing-dish in the pedestal under the box. As eat by degrees melts the composition between the es, the flower will gradually appear, but when the ng-dish is taken away, and the powder of the ashes is osed to be removed, the flower soon disappears.

u may present several flowers, and let the person se any one of them. In this case while he is burn-

ing the flower, you fetch the box from another apartme and at the same time put in a corresponding flower, wh will make the experiment still more surprising.

Imitative Fireworks.

Take a paper that is blacked on both sides, or inst of black, the paper may be coloured on each side wit deep blue, which will be still better for such as are to seen through transparent papers. It must be of a pro size for the figure you intend to exhibit. In this pa cut out with a penknife several spaces, and with a pie make a great number of holes, rather long than rou and at no regular distance from each other.

To represent revolving pyramids and globes, the pa must be cut through with a penknife, and the space out between each spiral should be three or four time wide as the spirals themselves. You must observe to them so that the pyramid or globe may appear to turn its axis. The columns that are represented in piece architecture, or in jets of fire, must be cut in the s manner, if they are to be represented as turning on t axes.

In like manner may be exhibited a great variet ornaments, cyphers, and medalions, which, when perly coloured, cannot fail of producing a most plea effect. There should not be a very great diversit colours, as that would not produce the most agree appearance.

When these pieces are drawn on a large scale, architecture or ornaments may be shaded, and to re sent different shades, pieces of coloured paper mus pasted over each other, which will produce an effect would not be expected from transparent paintings. or six pieces of Paper pasted over each other will sufficient to represent the strongest shades.

To give these pieces the different motions they requ you must first consider the nature of each piece; if example, you have cut out the figure of the sun, or star, you must construct a wire wheel of the same diam

with those pieces; over this wheel you paste a very thin paper, on which is drawn, with black ink, the spiral figure. The wheel thus prepared, is to be placed behind the sun or star, in such manner that its axis may be exactly opposite the centre of either of those figures. This wheel may be turned by any method you think proper.

Now, the wheel being placed directly behind the sun, for example, and very near to it, is to be turned regularly round, and strongly illuminated by candles placed behind it. The lines that form the spiral will then appear, through the spaces cut out from the sun, to proceed from its centre to its circumference, and will resemble sparks of fire that incessantly succeed each other. The same effect will be produced by the star, or by any other figure where the fire is not to appear as proceeding from the circumference of the centre.

These two pieces, as well as those that follow, may be of any size, provided you observe the proportion between the parts of the figure and the spiral, which must be wider in larger figures than in small. If the sun, for example have from six to twelve inches diameter, the width of the strokes that form the spiral need not be more than one-twentieth part of an inch, and the spaces between them, that form the transparent parts, about two tenths of an inch. If the sun be two feet diameter, the strokes should be one eighth of an inch, and the space between one, quarter of an inch; and if the figure be six feet diameter, the strokes should be one quarter of an inch and the spaces five twelfths of an inch. These pieces have a pleasing, effect when represented of a small size, but the deception is more striking when they are of larger dimensions.

It will be proper to place these pieces, when of a small size, in a box quite close on every side, that none of the light may be diffused in the chamber: for which purpose it will be convenient to have a tin door behind the box, to which the candlesticks may be soldered, and the candles more easily lighted.

The several figures cut out should be placed in frames, that they may be put, alternately, in a groove in the forepart of the box: or there may be two grooves, that the second piece may be put in before the first is taken out.

The wheel must be carefully concealed from the eye of the spectator.

Where there is an opportunity of representing these artificial fires by a hole in the partition, they will doubtless have a much more striking effect, as the spectator cannot then conjecture by what means they are produced.

It is easy to conceive that by extending this method, wheels may be constructed with three or four spirals, to which may be given different directions. It is manifest also, that on the same principle, a great variety of transparent figures may be contrived, and which may be all placed before the same spiral lines.

To represent Cascades of Fire.

In cutting out cascades, you must take care to preserve a natural inequality in the parts cut out; for if to save time, you should make all the holes with the same pointed tool, the uniformity of the parts will not fail to produce a disagreeable effect. As these cascades are very pleasing when well executed, so they are highly disgusting when imperfect. These are the most difficult pieces to cut out.

To produce the apparent motion of these cascades, instead of drawing a spiral, you must have a slip of strong paper, of such length as you judge convenient. In this paper, there must be a great number of holes near each other, and made with pointed tools of different dimensions.

At each end of the paper, a part, of the same size with the cascade, must be left uncut; and towards those parts the holes must be made a greater distance from each other. When the cascade that is cut out is placed before the scroll of paper just mentioned, and it is entirely wound upon the roller, the part of the paper that is then between being quite opaque, no part of the cascade will be visible; but as the winch is turned gently and regularly round, the transparent part of the paper will give to the cascade the appearance of fire that descends in the same direction; and the illusion will be so strong, that the spectators will think they see a cascade of fire; especially if the figure be judiciously out.

The Oracular Mirror.

PROVIDE a round mirror of about three inches in diameter, and whose frame is an inch wide. Line the under part of the frame, in which holes are to be cut, with very thin glass; behind this glass let a mirror, of about two inches diameter, be placed, which is to be moveable, so that by inclining the frame to either side, part of the mirror will be visible behind the glass on that side.

Then take Spanish chalk, or cypress vitriol, of which you make a pencil, and with this you may write on a glass, and rub it off with a cloth, and by breathing on the glass the writing will appear and disappear several times. With this pencil write on one side of the mirror, before it is put in the frame, the word *yes*, and on the other side *no*; and wipe them off with a cloth.

You propose to a person to ask any question of this mirror that can be answered by the word *yes*, or *no*. Then turning the glass to one side, and putting your mouth close to it, as if to repeat the question softly, you breathe on it, and the word *yes* or *no* will immediately appear. This mirror will serve for many other agreeable amusements.

The Hour of the Day or Night told by a suspended Shilling.

HOWEVER improbable the following experiment may appear, it has been proved by repeated trials;

Sling a shilling or sixpence at the end of a piece of thread by means of a loop. Then resting your elbow on a table, hold the other end of the thread betwixt your fore-finger and thumb; observing to let it pass across the ball of the thumb, and thus suspend the shilling into an empty goblet. Observe, your hand must be perfectly steady; and if you find it difficult to keep it in an immoveable posture, it is useless to attempt the experiment. Premising, however, that the shilling is properly suspended, you will observe, that when it has recovered its equilibrium, it will for a moment be stationary: it will then of its own accord, and without the least agency from the person holding it, assume

the action of a pendulum, vibrating from side to side of the glass; and after a few seconds, will strike the hour nearest to the time of day; for instance, if the time be twenty-five minutes past six, it will strike six; if thirty-five minutes past six, it will strike seven; and so of any other hour.

It is necessary to observe, that the thread should lay over the pulse of the thumb, and this may in some measure account for the *vibration* of the shilling; but to what cause its striking the precise hour is to be traced, remains unexplained; for it is no less astonishing than true, that when it has struck the proper number, its vibration ceases, it requires a kind of rotary motion, and at last becomes stationary as before.

Of Lightning, and the best Method of guarding against its mischievous Effects.

EXPERIMENTS made in electricity first gave philosophers a suspicion, that the matter of lightning was the same with the electric matter. Experiments afterwards made on lightning obtained from the clouds by pointed rods, received into bottles, and subjected to every trial, have since proved this suspicion to be perfectly well founded; and that whatever properties we find in electricity, are also the properties of lightning.

This matter of lightning, or of electricity, is an extreme subtle fluid, penetrating other bodies, and subsisting in them, equally diffused.

When, by any operation of art or nature, there happens to be a greater proportion of this fluid in one body than in another, the body which has most will communicate to that which has least, till the proportion becomes equal; provided the distance between them be not too great; or if it be too great, till there be proper conductors to convey it from one to the other.

If the communication be through the air without any conductor, a bright light is seen between the bodies, and a sound is heard. In small experiments, we call this light and sound the electric spark and snap; but in the great operations of nature, the light is what we call lightning, and the sound (produced at the same time, tho' generally arrivin

later at our ears than the light does to our eyes) is, with its echoes, called *thunder*.

If the communication of this fluid be a conductor, it may be without either light or sound, the subtle fluid passing in the substance of the conductor.

If the conductor be good, and of sufficient bigness, the fluid passes through it without hurting it. If otherwise, it is damaged or destroyed.

All metals, and water are good conductors.—Other bodies may become conductors by having some quantity of water in them, as wood, and other materials used in building, but not having much water in them, are not good conductors, and therefore are often damaged in the operation.

Glass, wax, silk, wool, hair, feathers, and even wood perfectly dry, are non-conductors: that is they resist instead of facilitating the passage of this subtle fluid.

When this fluid has an opportunity of passing through two conductors, one good and sufficient, as of metal; the other not so good, it passes in the best, and will follow in any direction.

The distance at which a body charged with this fluid will discharge itself suddenly, striking through the air into another body that is not charged, or not so highly charged is different according to the quantity of the fluid, the dimensions and form of the bodies themselves, and the state of the air between them.—This distance, whatever it happens to be between any two bodies, is called their *striking distance*, as, till they come within that distance of each other no stroke will be made.

The clouds have often more of this fluid in proportion than the earth; in which case, as soon as they come near enough, (that is, within the striking distance) or meet with a conductor, the fluid quits them and strikes into the earth. A cloud fully charged with this fluid, if so high as to be beyond the striking distance from the earth, passes quietly without making noise or giving light; unless it meets with other clouds that have less.

Tall trees, and lofty buildings, as the towers and spires of churches, become sometimes conductors between the clouds and the earth; but not being good ones, that is, not *conveying the fluid* freely, they are often damaged.

Buildings that have their roofs covered with lead, (er metal, and spouts of metal continued from the ro the ground to carry off the water, are never hurt by ning, as whenever it falls on such a building, it pa the metals and not in the walls.

When other buildings happen to be within the st distance from such clouds, the fluid passes in the whether of wood, brick, or stone, quitting the wal when it can find no better conductors near them, as rods, bolts, and hinges of windows or doors, gildi wainscot, or frames of pictures, the silvering on the of looking glasses, the wires for bells, and the bod animals, as containing watery fluids. And in p through the house it follows the direction of the ductors, taking as many in its way as can assist in i sage, whether in a straight or crooked line, leaping one to the other, if not far distant from each othe rending the wall in the spaces where these partial conductors are too distant from each other.

An iron rod being placed on the outside of a bui from the highest part continued down into the moist in any direction, straight or crooked, following the of the roof or other parts of the building, will recei lightning at its upper end, attracting it so as to p its striking any other part; and, affording it a good c ance into the earth, will prevent its damaging any p the building.

A small quantity of metal is found able to cond great quantity of this fluid. A wire no bigger t goose-quill has been known to conduct (with saf the building as far as the wire was continued) a tity of lightning that did prodigious damage both and below it: and probably larger rods are not nece though it is common in America to make them of l inch, some three quarters, or an inch diameter.

The rod may be fastened to the wall, chimney, &c staples of iron.—The lightning will not leave the good conductor) to pass into the wall (a bad co tor) through those staples. It would rather, if any in the wall, pass out of it into the rod, to get more r by that conductor into the earth.

If the building be very large and extensive, two or more rods may be placed at different parts, for greater security.

Small ragged parts of clouds, suspended in the air between the great body of clouds and the earth, (like leaf gold in electrical experiments) often serve as partial conductors for the lightning, which proceeds from one of them to another, and by their help comes within the striking distance to the earth or a building. It therefore strikes, through those conductors, a building that would otherwise be out of the striking distance.

Long sharp points communicating with the earth, and presented to such parts of clouds, drawing silently from them the fluid they are charged with, they are then attracted to the cloud, and may leave the distance so great as to be beyond the reach of striking.

It is therefore that we elevate the upper end of the rod six or eight feet above the highest part of the building, tapering it gradually to a fine sharp point, which is gilt to prevent its rusting.

Thus the pointed rod either prevents a stroke from the cloud, or if a stroke be made, conducts it to the earth with safety to the building.

The lower end of the rod should enter the earth so deep as to come at the moist part, perhaps two or three feet; and if bent when under the surface, so as to go in a horizontal line six or eight feet from the wall, and then bent again downwards three or four feet, it will prevent damage to any of the stones of the foundation.

A person apprehensive of danger from lightning, happening during the time of thunder to be in a house not so secured, will do well to avoid sitting near the chimney, near a looking glass, or any gilt pictures or wainscot; the safest place is in the middle of the room, (so it be not under a metal lustre suspended by a chain) sitting in one chair and laying the feet upon another. It is still safer to bring two or three matrasses or beds into the middle of the room, and, folding them up double, place the chair upon them: for they not being so good conductors as the walls, the lightning will not choose an uninterrupted course through the air of the room and the bedding, when it can *go through a continued* better conductor, the wall. But

where it can be had, a hammock, or swinging bed, pended by silk cords equally distant from the walls on ery side, and from the ceiling and floor above and bel affords the safest situation a person can have in any r whatever; and what indeed may be deemed quite i from danger of any stroke by lightning.

The Leech, a Prognosticator of the Weather.

Confine a leech in a large phial, three-parts filled v rain water, regularly changed thrice a week, and pla on a window frame, fronting the north. In fair and f ty weather it lies motionless and rolled up in a spiral fo at the bottom of the glass; but prior to rain or snov creeps up to the top, where if the rain will be heavy of some continuance, it remains a considerable time trifling, it quickly descends. Should the rain or snow accompanied with wind, it darts about its habitation v amazing celerity, and seldom ceases until it begins to b hard. If a storm of thunder and lightning be approach it is exceedingly agitated, and expresses its feelings ir olent convulsive starts, at the top of the glass. It is markable, that however fine and serene the weather r be, and not the least indication to change, either from barometer or any other cause whatsoever, yet, if the mal ever shift its position, or move in a desultory man so certain will the coincident results occur, within thi six hours, frequently within twenty-four, and someti in twelve; though its motions chiefly depend on the l and duration of the wet, and the strength of the wind.

The Awn of Barley, an Hydrometer.

The awn of barley is furnished with stiff points, wh like the teeth of a saw, are all turned towards the p of it; as this long awn lies upon the ground, it extends it in the moist air of night, and pushes forward the bar corn, which it adheres to in the day; it shortens as it dr and as these points prevent it from receding, it draws u *pointed end:* and thus, creeping like a worm, will tr

eet from the parent stem. That very ingenious
ıic philosopher, Mr. Edgeworth, once made on this
le a wooden automaton ; its back consisted of soft
d, about an inch square, and four feet long, made of
cut the cross-way in respect to the fibres of the
ınd glued together; it had two feet before, and two
, which supported the back horizontally, but were
with their extremities, which are armed with sharp
of iron, bending backwards. Hence, in moist wea-
he back lengthened, and the two foremost feet
ıushed forwards; in dry weather the hinder feet
rawn after, as the obliquity of the points of the feet
ted it from receding. Might not this machine be
. as an hydrometer to some meteorological purpose ?

Power of Water when reduced to Vapour by Heat.

TEVER force water may have while its parts remain
:r, is nothing, if compared to the almost incredible
with which its parts are endued, when they are
l to vapour by heat. Those steams which we see
rom the surface of boiling water, and which to us
feeble, yet if properly conducted, acquire immense
In the same manner as gunpowder has but small
if suffered to expand at large, so the steam issuing
ater is impotent, where it is permitted to evapo-
o the air; but where confined in a narrow com-
s, for instance, where it rises in an iron tube
on every side, it there exerts all the wonders of
ıgth. *Muschenbrook* has proved, by experiment,
: force of gunpowder is feeble when compared to
rising steam. An hundred and forty pounds of
/der blew up a weight of thirty thousand pounds ;
the other hand, an hundred and forty pounds of
converted by heat into steam, lifted a weight of
-seven thousand pounds; and would still lift a
reater, if there were means of giving the steam
heat with safety; for the hotter the steam, the
is its force.

Artificial Memory.

In travelling along a road, the sight of the more remarkable scenes we met with, frequently puts us in mind of the subjects we were thinking or talking of when we last saw them. Such facts, which are perfectly familiar, even to the vulgar, might very naturally suggest the possibility of assisting the memory, by establishing a connexion between the ideas we wish to remember, and certain sensible objects, which have been found from experience to make a permanent impression on the mind. It was said, that a person contrived a method of committing to memory the sermons which he was accustomed to hear, by fixing his attention, during the different heads of the discourse, on different compartments of the roof of the church, in such a manner, as that when he afterwards saw the roof, or recollected the order in which its compartments were disposed, he recollected the method which the preacher had observed in treating his subject. This contrivance was perfectly analogous to the topical memory of the ancients; an art, which, whatever be the opinion we entertain of its use, is certainly entitled, in a high degree, to the praise of ingenuity.

Suppose you fix in your memory the different apartments in some very large building, and that you had accustomed yourself to think of these apartments always in the same invariable order. Suppose farther, that, in preparing yourself for a public discourse, in which you had occasion to treat of a great variety of particulars, you were anxious to fix in your memory the order you proposed to observe in the communication of your ideas. It is evident, that, by a proper division of your subject into heads, and by connecting each head with a particular apartment, (which you could easily do, by conceiving yourself to be sitting in the apartment while you were studying the part of your discourse you meant to connect with it,) the habitual order in which these apartments occurred to your thoughts, would present to you in their proper arrangement, and without any effort on your part, the ideas of which you are to treat. It is also obvious, that very little practice would enable you to avail yourself of this contrivance, without any embarrassment or distraction of your attention.

To procure Hydrogen Gas.

PROVIDE a phial with a cork stopper, through which is thrust a piece of tobacco-pipe. Into the phial put a few pieces of zinc, or small iron nails; on this pour a mixture, of equal parts, of sulphuric acid, (oil of vitriol,) and water, previously mixed in a tea-cup, to prevent accidents. Replace the cork stopper, with the piece of tobacco-pipe in it; the hydrogen gas will then be liberated through the pipe into a small stream. Apply the flame of a candle or taper to this stream, and it will immediately take fire, and burn with a clear flame until all the hydrogen in the phial be exhausted. In this experiment the zinc or iron, by the action of the acid, becomes oxigenised, and is dissolved, thus taking the oxigen from the sulphuric acid and water; the hydrogen (the other constituent part of the water) is thereby liberated and ascends.

To fill a Bladder with Hydrogen Gas.

APPLY a bladder, previously wetted and compressed, in order to squeeze out all the common air, to the piece of tobacco-pipe inserted in the cork stopper of the phial, (as described in the experiment above.) The bladder will thus be filled with hydrogen gas.

Exploding Gas Bubbles.

ADAPT the end of a common tobacco-pipe to a bladder filled with hydrogen gas, and dip the bowl of the pipe into soap-suds, prepared as if for blowing up soap bubbles; squeeze out small portions of gas from the bladder into the soap-suds, and the bubbles will ascend into the air with very great rapidity, until they are out of sight. If a lighted taper or candle be applied to the bubbles as they ascend from the bowl of the pipe, they will explode with *a loud noise.*

Another Method.

Put a small quantity of phosphorus and some potash, dissolved into water, into a retort; apply the flame of a candle or lamp to the bottom of the retort, until the contents boil. The phosphuretted hydrogen gas will then rise, and may be collected in receivers. But if, instead of receiving the gas into a jar, you let it simply ascend into water, the bubbles of gas will then explode in succession, as they reach the surface of the water, and a beautiful white smoke will be formed, which rises slowly and majestically to the ceiling. If bits of phosphorus are kept some hours in hydrogen gas, phosphorized hydrogen gas is produced; and if bubbles of this gas are thrown up into the receiver of an air-pump, previously filled with oxygen gas, a brilliant bluish flame will immediately fill the jar.

Singular Impression on the visual Nerves by a luminous Object.

If, while setting in a room, you look earnestly at the middle of a window a little while, when the day is bright, and then shut your eyes, the figure of the window will still remain in your eye, and so distinct that you may count the panes. A remarkable circumstance attending this experiment is, that the impression of forms is better retained than that of colours; for after the eyes are shut, when you first discern the image of the window, the panes appear dark, and the cross-bars of the sashes, with the window frames and walls, appear white and bright; but if you still add to the darkness of the eyes, by covering them with your hand, the reverse instantly takes place, the panes appear luminous, and the cross-bars dark; and by removing the hand, they are again reversed.

Curious Effects of Oil upon Water, and Water upon Oil.

Fasten a piece of pack thread round a tumbler with strings of the same from each side, meeting above it in a knot at about a foot distance from the top of the tumbler. *Then putting* in as much water as will fill about one-third

Weather Table.

If the new or full moon enters into the first or last quarter of the hour of 12 at noon.	Very rainy	Snow and rain
If between the hours of . . . . (P. M.) 2 and 4	Changeable	Fair and mild
4 and 6	Fair	Fair
6 and 8	Fair, if wind at N. W.	Fair and frosty, if wind at N. or N. E.
	Rainy, if wind at S. or S. W.	Rain or snow, if S. or S. W.
8 and 10	Ditto	Ditto
10	Fair	Fair and frosty
(A. M.) 2	Ditto	Hard frost, unless wind S. S. W.
2 and 4	Cold, with frequent showers	
4 and 6	Rain	Ditto, ditto
6 and 8	Wind and rain	Stormy weather
8 and 10	Changeable	Cold and rain, if wind N. snow if E.
10 and 12	Frequent showers	Cold, with high wind

part of the tumbler, lift it up by the knot, and swing it to and fro in the air; and the water will keep its place as steadily in the glass as if it were ice. But pour gently in upon the water about as much oil, and then again swing it in the air as before; the tranquillity before possessed by the water will be transferred to the surface of the oil, and the water under it will be violently agitated.

Another Curious Experiment with Oil and Water.

Drop a small quantity of oil into water agitated by the wind; it will immediately spread itself with surprising swiftness upon the surface, and the oil, though scarcely more than a tea-spoon full, will produce an instant calm over a space several yards square. It should be done on the windward side of the pond or river, and you will observe it extend to the size of nearly half an acre, making it appear as smooth as a looking-glass. One remarkable circumstance in this experiment is, the sudden, wide, and forcible spreading of a drop of oil on the surface of the water; for if a drop of oil is put upon a highly polished marble table, or a looking-glass, laid horizontally, the drop remains in its place, spreading very little, but when dropped on water it spreads instantly many feet round, becoming so thin as to produce the prismatic colours for a considerable space, and beyond them so much thinner as to be invisible, except in its effect of smoothing the waves at a much greater distance. It seems as if a repulsion of its particles took place as soon as it touched the water, and so strong as to act on other bodies swimming on the surface, as straw, leaves, chips, &c. forcing them to recede every way from the drop as from a centre, leaving a large clear space.

Remarkable Effects on the visual Nerves by looking through differently coloured Glasses.

After looking through green spectacles, the white paper of a book will, on first taking them off, appear to have a blush of red; and after looking through red glasses, a greenish cast. This seems to intimate a relation between green and red, not yet explained.

A COMPLETE

SYSTEM OF PYROTECHNY,

OR THE

Art of making Fire-Works.

In the art of making fire-works, great attention must be id to the well mixing of the materials, without which labour is thrown away, to the purity of the articles, d to the proper quantities of each. Sulphur, to be good, ust be of a high colour, and crack and bounce when ld in the hand. For small fire-works, such as may be ught in the flour will be found quite good enough, but the larger kinds, the lump brimstone ground is pre-able.

Benjamin is used in fire-works, more for its pleasant nt than any material use for the purposes of fire. It y be procured at the chemists' ready for use. The oil also used in wet compositions, for stars, &c.

Of Sulphur, or Brimstone.

Sulphur is by nature the food of fire, and one of the ncipal ingredients in gunpowder, and almost in all npositions of fire-works; therefore, great care ought to taken of its being good, and brought to the highest fection. Now, to know when the sulphur is good, you to observe that it be of a high yellow, and if, when d in one's hand, it crackles and bounces, it is a sign t it is fresh and good; but as the method of reducing mstone to a powder is very troublesome, it is better buy the flour ready-made, which is done in large ntities, and in great perfection; but when a great ntity of fire-works is to be made, it is best to use the p brimstone ground, in the same manner as gunpowder.

Of Saltpetre.

SALTPETRE being the principal ingredient in fire-works, and a volatile body, by reason of its aqueous and aërial parts, is easily rarified by fire; but not so soon when foul and gross, as when purified from its gross and earthy parts, which greatly retard its velocity: therefore, when any quantity of fire-works is intended to be made, it would be necessary first to examine the saltpetre; for if it be not well cleansed from all impurities, and of a good sort, your works will not have their proper effect.

To pulverize Saltpetre.

TAKE a copper kettle, the bottom being spherical and put into it fourteen pounds of refined saltpetre, with two quarts or five pints of clean water; then put the kettle on a slow fire, and when the saltpetre is dissolved, if any impurities arise, skim them off, and keep constantly stirring it with two large spatulas, till all the water exhales; and when done enough, it will appear like white sand, and as fine as flour; but if it should boil too fast, take the kettle off the fire, and set it on some wet sand, which will prevent the nitre from sticking to the kettle. When you have pulverized a quantity of saltpetre, be careful to keep it in a dry place.

To prepare Charcoal for Fire-works.

CHARCOAL is a preservative, by which the salpetre and brimstone are made into gunpowder, by preventing the sulphur from suffocating the strong and windy exhalation of the nitre. There are several sorts of wood made use of for this purpose; some prefer hazel, others willow, and others alder. The method of burning the wood is this: cut it in pieces of two or three feet long, then slit each piece in four parts; scale off the bark and hard knots, and dry them in the sun, or in an oven; then make in the earth a square hole, and line it with bricks, in which lay the wood crossing one another, and set it on fire; when

thoroughly lighted, and in a flame, cover the hole with boards, and fling earth over them close, to prevent the air from getting in, yet so as not to fall among the charcoal; and when it has lain thus for twenty-four hours, take out the coals and lay them in a dry place for use. It is to be observed that charcoal for fire-works must always be soft and well burnt, which may be bought ready done.

Of Gunpowder, &c.

Gunpowder being a principal ingredient in fire-works, it will not be improper to give a short definition of its strange explosive force, and cause of action, which, according to Dr. Shaw's opinion of the chemical cause of the explosive force of gunpowder, is as follows:—"Each grain of gunpowder consisting of a certain proportion of sulphur nitre, and coal, the coal presently takes fire, upon contact of the smallest spark; at which time both the sulphur and the nitre immediately melt, and by means of the coal interposed between them, burst into flame; which spreading from grain to grain, propagates the same effect almost instantaneously, whence the whole mass of powder comes to be fired; and as nitre contains a large proportion both of air and water, which are now violently rarified by the heat, a kind of fiery explosive blast is thus produced, wherein the nitre seems, by its aqueous and aërial parts, to act as bellows to the other inflammable bodies (sulphur and coal) to blow them into a flame, and carry off their whole substance in smoke and vapour."

How to meal Gunpowder, Brimstone, and Charcoal.

There have been many methods used to grind these ingredients to a powder for fire-works, such as large mortars and pestles made of ebony, and other hard woods; but none of these methods have proved so effectual and speedy as the last invention, that of the mealing table. This table is made of elm, with a rim round its edge, four *or five inches high*; and at the narrow end is a slider,

which runs in a groove one forms part of the rim; so that when you have taken out of the table as much powder as you conveniently can, with a copper shovel, you may sweep all clean out at the slider. When you are going to meal a quantity of powder observe not to put too much on the table at once; but when you have put in a good proportion, take a muller and rub it therewith till all the grains are broken; then searce it in a lawn sieve, that has a receiver and top to it; and that which does not pass through the sieve, return again to the table and grind it more, till you have brought it fine enough to go through the sieve. Brimstone and charcoal are ground in the same manner as gunpowder, only the muller must be made of ebony, for these ingredients being harder than powder, would stick in the grain of the elm, and be very difficult to grind; and as the brimstone is apt to stick and clog to the table, it would be best to keep one for that purpose only, by which means you will always have your brimstone clean and well ground.

Spur Fire.

This fire is the most beautiful of any composition yet known. As it requires great trouble to bring it to perfection, particular care must be paid to the following instructions. They are made generally in cases about six inches long, but not drove very hard.

CHARGE.	*lb.*	*oz.*		CHARGE.	*lb.*	*oz.*
Saltpetre	4	0	or	Saltpetre	4	0
Sulphur	2	0		Sulphur	0	8
Lamp-black	1	8		Lamp-black	4 quarts.	

This composition is very difficult to mix. The saltpetre and brimstone must be first sifted together, and then put into a marble mortar, and the lamp-black with them, which you work down by degrees with a wooden pestle, till all the ingredients appear of one colour, which will be something greyish, but very near black: then drive a little into a case for trial, and fire it in a dark place; and if the sparks, which are called stars, or pinks, come out in clusters, and afterwards spread well without any other sparks, it is a sign of its being good, otherwise, not; for if

any drossy sparks appear, and the stars not full, it is then not mixed enough; but if the pinks are very small, and soon break, it is a sign that you have rubbed it too much.

This mixture when rubbed too much, will be too fierce, and hardly show any stars; and, on the contrary, when not mixed enough, will be too weak, and throw out an obscure smoke, and lumps of dross, without any stars. The reason of this charge being called the spur fire is, because the sparks it yields have a great resemblance to the rowel of a spur, from whence it takes its name. As the beauty of this composition cannot be seen at so great a distance as brilliant fire, it has a better effect in a room than in the open air, and may be fired in a chamber without any danger; it is of so innocent a nature, that, though an improper phrase, it may be called a cold fire; and so extraordinary is the fire produced from this composition, that, if well made, the sparks will not burn a handkerchief when held in the midst of them; you may hold them in your hand while burning with as much safety as a candle; and if you put your hand within a foot of the case, you will feel the sparks fall like drops of rain.

To make Touch-Paper.

Dissolve in some spirits of wine or vinegar, a little saltpetre; then take some purple or blue paper, wet it with the above liquor, and when dry it will be fit for use. When you paste this paper on any of your works, take care that the paste does not touch that part which is to burn. The method of using this paper is, by cutting it into slips, long enough to go once round the mouth of the serpent, cracker, &c. When you paste on these slips, leave a little above the mouth of the case not pasted; then prime the case with meal powder, (see p. 177) and twist the paper to a point.

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Weather Table.

NEW AND FULL MOON.	SUMMER.	WINTER.
If the new or full moon enters into the first or last quarter of the hour of 12 at noon.	Very rainy	Snow and rain
If between the hours of . . . . (P. M.) 2 and 4	Changeable	Fair and mild
4 and 6	Fair	Fair
6 and 8	Fair, if wind at N. W.	Fair and frosty, if wind at N. or N. E.
	Rainy, if wind at S. or S. W.	Rain or snow, if S. or S. W.
8 and 10	Ditto	Ditto
10	Fair	Fair and frosty
(A. M.) 2	Ditto	Hard frost, unless wind S. S. W.
2 and 4	Cold, with frequent showers	
4 and 6	Rain	Ditto, ditto
6 and 8	Wind and rain	Stormy weather
8 and 10	Changeable	Cold and rain, if wind N. snow if E.
10 and 12	Frequent showers	Cold, with high wind

these pieces fold down lengthwise about three quarters of an inch broad; then fold the double edge down a quarter of an inch, and turn the single edge back half over the double fold; open it, and lay all along the channel, which is formed by the foldings of the paper, some meal powder; then fold it over and over till all the paper is doubled up, rubbing it down every turn; this being done, bend it backwards and forwards, two inches and an half, or thereabouts, at a time, as often as the paper will allow: hold all these folds flat and close, and with a small pinching cord, give one turn round the middle of the cracker, and pinch it close; bind it with packthread, as tight as you can, then in the place where it was pinched, prime one end, and cap it with touch paper. When these crackers are fired, they will give a report at every turn of the paper, if you would have a great number of bounces, you must cut the paper longer, or join them after they are made; but if they are made very long before they are pinched, you must have a piece of wood with a groove in it, deep enough to let in half the cracker; this will hold it straight while it is pinching.

To make Squibs and Serpents.

First make the cases, of about six inches in length by rolling slips of stout cartridge paper three times round a roller, and pasting the last fold; tying it near the bottom as tight as possible, and making it air-tight at the end by sealing-wax.—Then take of gunpowder half a pound, charcoal, one ounce, brimstone one ounce, and steel filings half an ounce, (or in like proportion) grind them with a muller, or pound them in a mortar. Your cases being dry and ready, first put a thimble full of your powder, and ram it hard down with a ruler; then fill the case to the top with the aforesaid mixture, ramming it hard down in the course of filling two or three times; when this is done, point it with touch paper, which should be pasted on that part which touches the case, otherwise it is liable to drop off.

Sky-Rockets.

ROCKETS being of the fire-works most in use, we shall give them the preference in description. As the performance of Rockets depends much upon their moulds, they should be made according to the following proportions:—Taking the diameter of the orifice, its height should be equal to six diameters and two thirds; the choke, one diameter and one third of this model will serve for every rocket from 4 oz. to 6 lb.—For instance: suppose the diameter of a rocket of 1 lb. be 1½ inch, then its length being 6 diameters and two-thirds; the length of the case must be 10½ inches, and the choke 2¼ inches. Your rammer must have a collar of brass to prevent the wood from splitting.

Method of rolling Rocket Cases.—The cases must be made of the strongest cartridge paper, and rolled dry. The case of a middling sized rocdet will take up paper of four or five sheets thick; having cut your papers to a proper size, and the last sheet with a slope at one end, fold down one end, and lay your former on the double edge, and when you have rolled on the paper within two or three turns, lay the next sheet on that part which is loose, and roll it all on. Then, in order to roll the case as hard as possible, place it on a table and with a smooth board; roll it for some time forwards on the table till it becomes quite hard and firm. This must be done with every sheet. You have next to choke the case, for which purpose draw your former a little distance from the bottom, then, with a cord once round the case, pull it rather easy at first, and harder, till you have closed the end. To make it easy, you may dip the ends of the inner sheets in water before rolling, then bind it with small twine.

Having thus pinched and tied the case so as not to give way, put it into the mould without its foot, and with a mallet drive the former hard on the end-piece, which will force the neck close and smooth. This done, cut the case to its proper length, allowing from the neck to the edge of the mouth half a diameter, which is equal to the height of the nipple; then take out the former, and drive the case over the piercer with a long rammer, and the vent will be of a proper size.

Having formed your cases, we will now proceed to the description of the ingredients necessary for the rocket.

Of mixing the Composition.—The performance of the principal part of fire-works depends much on the compositions being well mixed; therefore, great care must be taken in this part of the work, particularly for the composition for sky-rockets. When you have four or five pounds of ingredients to mix, which is a sufficient quantity at a time, (for a larger proportion will not do so well) first put the different ingredients together, then work them about with your hands, till you think they are pretty well incorporated; after which, put them into a lawn sieve with a receiver and top to it; and if, after it is sifted any remains that will not pass through the sieve, grind it again till it is fine enough; and if it be twice sifted, it will not be amiss; but the compositions for wheels and common works are not so material, nor need be so fine. But in all fixed works, from which the fire is to play regular, the ingredients must be very fine, and great care taken in mixing them well together; and observe, that in all compositions wherein are iron filings, the hand must not touch them; nor will any works which have iron or steel in their charge keep long in damp weather.

To drive or ram Rockets.—Rockets are filled hollow, otherwise they would not ascend, and there is not a part that requires greater attention than this stage of the process. One blow more or less with the mallet will spoil the ascent.

The charge of rockets must always be drove above the piercer, and on it must be rammed a thin head of clay; through the middle of which bore a small hole to the composition, that, when the charge is burnt to the top, it may communicate its fire through the hole to the stars in the head.

To a rocket of four ounces, give to each ladle-full of charge 16 strokes; to a rocket of 1 lb. 28; to a 2-pounder, 36; to a 4-pounder, 42; and to a 6-pounder, 56: but rockets of a larger sort cannot be driven well by hand, but must be rammed with a machine made in the same manner as those for driving piles.

The method of ramming wheel cases, or any other sort in which the charge is driven solid, is the same as sky-rockets.

When you load the heads of your rockets with stars, rains, serpents, crackers, scrolls, or any thing else, according to your fancy, remember always to put a ladle-full of meal powder into each head, which will be enough to burst the head, and disperse the stars, or whatever it contains.

Decorations for Sky-Rockets.—Sky-rockets may be decorated according to fancy. Some are headed with stars of different sorts, such as tailed, brilliant, white, blue, and yellow stars, &c. Some with gold and silver rains; others with serpents, crackers, fire-scrolls, and marrons; and some with small rockets and other devices, as the maker pleases.

LENGTH OF ROCKET STICKS.

For rockets of 6lb.	0 oz.	the stick must be 14ft.	10 in. long
4	0	12	10
2	0	9	4
1	0	8	2
0	8	6	6
0	4	5	3

Having your sticks ready, cut on one of the flat sides at the top a groove the length of the rocket, and as broad as the stick will allow; then on the opposite flat side, cut two notches for the cord, which ties on the rocket, to lie in; one of these notches must be near the top of the stick, and the other facing the neck of the rocket; the distance between these notches may be easily known, for the top of the stick should always touch the head of the rocket. When your rockets and sticks are ready, lay the rockets in the grooves in the sticks, and tie them on. We will now proceed to the charge for sky-rockets.

ROCKETS OF FOUR OUNCES.

	lb.	oz.		lb.	oz.
Meal-powder	1	4	Charcoal	0	2
Saltpetre	0	4			

ROCKETS OF EIGHT OUNCES.

	lb.	oz.		lb.	oz.
Meal-powder	1	0	Brimstone	0	3
Saltpetre	0	4	Charcoal	0	1½

ONE POUND.

	lb.	oz.		lb.	oz.
Meal-powder	2	0	Charcoal	0	2
Saltpetre	0	8	Steel-filings	0	1½
Brimstone	0	4			

SKY-ROCKETS IN GENERAL.

	lb.	oz.		lb.	oz.
Saltpetre	4	0	Charcoal	1	12
Brimstone	1½	0	Meal-powder	0	2

LARGE SKY-ROCKETS.

	lb.	oz.		lb.	oz.
Saltpetre	4	0	Brimstone	1	0
Meal-powder	1	0			

ROCKETS OF A MIDDLING SIZE.

	lb.	oz.		lb.	oz.
Meal-powder	1	0	Saltpetre	3	0
Charcoal	1	0	Sulphur	2	0

ROCKET STARS.

WHITE STARS.

	lb.	oz.		lb.	oz.
Meal-powder	0	4	Oil of spike	0	2
Saltpetre	0	12	Camphor	0	5
Sulphur vivum	0	6			

BLUE STARS.

	lb.	oz.		lb.	oz.
Meal-powder	0	8	Spirits of wine	0	2
Saltpetre	0	4	Oil of spike	0	2
Sulphur	0	2			

VARIEGATED STARS.

	lb.	oz.		lb.	oz.
Meal-powder	0	0½	Sulphur vivum	0	2
Saltpetre	0	4	Camphor	0	2

BRILLIANT STARS.

	lb.	oz.		lb.	oz.
Saltpetre	0	3½	Meal-powder	0	0¾
Sulphur	0	1½			

Worked up with spirits of wine only.

COMMON STARS.

	lb.	oz.		lb.	oz.
Saltpetre	1	0	Isinglass	0	0½
Brimstone	0	4	Camphor	0	0¼
Antimony	0	4¾	Spirits of Wine	0	0¼

TAILED STARS.

	lb.	oz.		lb.	oz.
Meal-powder	0	2	Saltpetre	0	2
Brimstone	0	2	Charcoal (coarsely ground)	0	0¾

STARS OF A FINE COLOUR.

	lb.	oz.		lb.	oz.
Sulphur	0	1	Camphor	0	0¼
Meal-powder	0	1	Oil of turpentine	0	0¼
Saltpetre	0	1			

RAINS.

GOLD RAIN FOR SKY-ROCKETS.

	lb.	oz.		lb.	oz
Saltpetre	0	8	Antimony	0	0¾
Brimstone	0	2	Brass-dust	0	0¼
Glass-dust	0	1	Saw-dust	0	1¼

SILVER RAIN.

	lb.	oz.		o.	oz.
Saltpetre	0	8	Charcoal	0	4
Brimstone	0	2	Steel dust	0	0¾

To fix one Rocket on the top of another.—When sky-rockets are fixed one on the top of another, they are called *towering rockets*, on account of their mounting so very high. Towering rockets are made after this manner: fix on a pound-rocket a head without a collar; then take a four ounce rocket, which may be headed or bounced, and rub the mouth of it with meal-powder wetted with spirit of wine: this done, put in the head of the large rocket with its mouth downwards; but before it is put in, stick a bit of quick-match in the hole of the clay of the pound-rocket, which match should be long enough to go a little way up the bore of the small rocket, to fire when the large rocket is burnt out. As the four ounce rocket is too small to fill the head of the other, roll round it a much tow

as will make it stand upright in the centre of the head: the rocket being thus fixed, paste a single paper round the opening of the top of the head of the large ocket. The large rocket must have only half a diameter of charge rammed above the piercer; for, if filled to the usual height, it would turn before the small one takes fire, and entirely destroy the intended effect: when one rocket is headed with another, there will be no occasion for any blowing of powder; for the force with which it goes off will be sufficient to disengage it from the head of the first fired rocket. The sticks for these rockets must be a little longer than for those headed with stars, rains, &c.

Caduceus Rockets.—They are such as in rising, form two spiral lines, by reason of their being placed obliquely, one opposite to the other; and their counterpoise in the centre, which causes them to rise in a vertical direction. Rockets for this purpose must have their ends choaked close without either head or bounce, for a weight at top would be a great obstruction to their mounting. No caduceus rockets ascend so high as single, because of their serpentine motion, and likewise the resistance of air, which is much greater than two rockets of the same size would meet with if fired singly.

The sticks for this purpose must have all their sides equal, and the sides should be equal to the breadth of a stick proper for a sky-rocket of the same weight as those you intend to use, and made to taper downwards as usual, long enough to balance them, one length of a rocket from the cross stick; which must be placed from the large stick six diameters of one of the rockets, and its length seven diameters; so that each rocket, when tied on, may form with the large stick an angle of 60 degrees. In tying on the rockets, place their heads on the opposite sides of the cross stick, and their ends on the opposite sides of the long stick; then carry a leader from the mouth of one into that of the other. When these rockets are to be fired, suspend them between two hooks or nails, then burn the leader through the middle, and both will take fire at the same time. Rockets of 1 lb. are a good size for this use.

Honorary Rockets.—These are the same as sky-rockets, except that they carry no head nor report, but are closed

at top, on which is fixed a cone: then on the case close to the top of the stick is tied on a two ounce case, about five or six inches long, filled with a strong charge, and pinched close at both ends; then in the reverse sides, at each end, bore a hole in the same manner as in tourbillons, to be presently described; from each hole carry a leader into the top of the rocket. When the rocket is fired, and arrived to its proper height, it will give fire to the case at top; which will cause both rocket and stick to spin very fast in their return, and represent a worm of fire descending to the ground.

There is another method of placing the small case, which is by letting the stick rise a little above the top of the rocket, and tying the case to it, so as to rest on the rocket: these rockets have no cones.

A third method by which they are managed is this: In the top of a rocket fix a piece of wood, in which drive a small iron spindle; then make a hole in the middle of the small case, through which put the spindle: then fix on the top of it a nut, to keep the case from falling off; when this is done, the case will turn very fast, without the rocket: but this method does not answer so well as either of the former.

To make a Rocket form an Arch in Rising.—Having some rockets made, and headed according to fancy, and tied on their sticks; get some sheet tin, and cut it into round pieces about three or four inches diameter; then on the stick of each rocket, under the mouth of the case, fix one of these pieces of tin 16 inches from the rocket's neck, and support it by a wooden bracket, as strong as possible: the use of this is, that when the rocket is ascending, the fire may play with great force on the tin, which will divide the tail in such a manner that it will form an arch as it mounts, and will have a very good effect when well managed: if there is a short piece of port-fire, of a strong charge, tied to the end of the stick, it will make a great addition; but this must be lighted before the rocket is fired.

To make several Rockets rise together.—Take six, or any number of sky-rockets, of any size; then cut some strong packthread into pieces of three or four yards long, and tie *each end of these* pieces to a rocket in this manner:

Having tied one end of the packthread round the b one rocket, and the other end to another, take a s piece of packthread, and make one end of it fast to the rockets already tied, and the other end to a rocket, so that all the rockets, except the two on tl side, will be fastened to two pieces of packthrea length of thread from one rocket to the other may b the maker pleases; but the rockets must be all of and their heads filled with the same weight of rains, &c.

Having thus done, fix in the mouth of each ro leader of the same length: and when about to fire hang them close; then tie the ends of the leaders to and prime them: this prime being fired, all the r will mount at the same time, and divide as far as the will allow; and this division they will keep, provide are all rammed alike, and well made. They are times called *chained rockets*.

To fix several Rockets to the same stick.—Two, th six sky-rockets, fixed on one stick, and fired tog make a grand and beautiful appearance; for the all will seem but as one of an immense size, and the ing of so many heads at once will resemble the b of an air balloon. The management of this devi quires a skilful hand; but if the following instructi well observed, even by those who have not made progress in this art, there will be no doubt of the r having the desired effect.

Rockets for this purpose must be made with the est exactness, all rammed by the same hand: in th mould, and filled with the same proportion of compo and after they are filled and headed, must be all same weight. The stick must also be well made proportioned) to the following directions: first, sing the rockets to be half pounders, whose sticks feet six inches long, then if two, three, or six of thes be fixed on one stick, let the length of it be nine fe inches: then cut the top of it into as many sides a are rockets: and let the length of each side be equa length of one of the rockets without its head; and side cut a groove (as usual); then from the groove

it round, down to the bottom, where its thickness must be equal to half the top of the round part. As their thickness cannot be exactly ascertained, we shall give a rule which generally answers for any number of rockets above two: the rule is this; that the stick at top must be thick enough, when the grooves are cut, for all the rockets to lie, without pressing each other, though as near as possible.

When only two rockets are to be fixed on one stick, let the length of the stick be the last given proportion, but shaped after the common method, and the breadth and thickness double the usual dimensions. The point of poise must be in the usual place (let the number of rockets be what it will): if sticks made by the above directions should be too heavy, plane them thinner; and if too light, make them thicker; but always make them of the same length.

When more than two rockets are tied on one stick, there will be some danger of their flying up without the stick, unless the following precaution is taken: For cases being placed on all sides, there can be no notches for the cord which ties on the rockets to lie in; therefore, instead of notches, drive a small nail in each side of the stick, between the necks of the cases: and let the cord, which goes round their necks, be brought close under the nails; by this means the rockets will be as secure as when tied on singly. The rockets being thus fixed, carry a quick-match, without a pipe, from the mouth of one rocket to the other; this match being lighted will give fire to all at once.

Though the directions already given may be sufficient for these rockets, we shall here add an improvement on a very essential part of this device, which is, that of hanging the rockets to be fired; for before the following method was contrived, many attempts proved unsuccessful. Instead, therefore, of the old and common manner of hanging them on nails or hooks, make use of the following contrivance: Have a ring made of strong iron wire large enough for the stick to go in as far as the mouths of the rockets; then have another ring supported by a small iron, at some distance from the post or stand to which it is fixed: then have another ring fit to receive and guide the small end of the stick. Rockets thus suspended will

obstruct their fire; but when they are hung on nails or hooks, in such a manner that some of their mouths are against or upon a rail, the there can be no certainty of their rising in a vertical direction.

To fire Rockets without Sticks.—You must have a stand, of a block of wood, a foot diameter, and make the bottom flat, so that it may stand steady: in the centre of the top of this block draw a circle two inches and a half diameter; and divide the circumference of it into three equal parts; then take three pieces of thick iron wire, each about three feet long, and drive them into the block, one at each point made on the circle; when these wires are driven in deep enough to hold them fast and upright, so that the distance from one to the other is the same at top as at bottom, the stand is complete.

The stand being thus made, prepare the rockets thus: Take some common sky-rockets of any size, and head them as you please; then get some balls of lead, and tie to each a small wire two or two feet and a half long, and the other end of each wire tie to the neck of a rocket. These balls answer the purpose of sticks when made of a proper weight, which is about two-thirds the weight of the rocket; but when they are of a proper size, they will balance the rocket in the same manner as a stick, at the usual point of poise. To fire these, hang them, one at a time, between the tops of the wires, letting their heads rest on the point of the wires, and the balls hang down between them: if the wires should be two wide for the rockets, press them together till they fit; and if too close, force them open; the wires for this purpose must be softened, so as not to have any spring, or they will not keep their position when pressed close or opened.

Scrolls for Rockets.—Cases for scrolls should be made four or five inches in length, and their interior diameters three-eights of an inch: one end of these cases must be pinched quite close before beginning to fill; and when filled, close the other end: then in the opposite sides make a small hole at each end, to the composition, as in tourbillons; and prime them with wet meal-powder. You may put in the head of a rocket as many of these cases as it will contain: being fired they turn very quick in the

air and form a scroll or spiral line. They are generally filled with a strong charge, as that of serpents or brilliant fire.

Stands for Rockets.—Care must be taken in placing the rockets, when they are to be fired, to give them a vertical direction at their first setting out; which may be managed thus: Have two rails of wood, of any length, supported at each end by a perpendicular leg, so that the rails may be horizontal, and let the distance from one to the other be almost equal to the length of the sticks of the rockets intended to be fired; then in front of the top rail drive square hooks at eight inches distance, with their points turned sidewise, so that when the rockets are hung on them, the points will be before the sticks, and keep them from falling or being blown off by the wind; in the front of the rail at bottom must be staples, driven perpendicularly under the hooks at top; through these staples put the small ends of the rocket sticks. Rockets are fired by applying a lighted port-fire to their mouths.

Table Rockets.—Table rockets are designed merely to show the truth of driving, and the judgment of a fire-worker; they having no other effect, when fired, than spinning round in the same place where they begin, till they are burnt out, and showing nothing more than an horizontal circle of fire.

The method of making these rockets is,—Have a cone turned out of hard wood two inches and a half in diameter, and as much high; round the base of it drive a line; on this line fix four spokes, each two inches long, so as to stand one opposite the other; then fill four nine-inch one pound cases with any strong composition, within two inches of the top: these cases are made like tourbillons, and must be rammed with the greatest exactness.

The rockets being filled, fix their open ends on the short spokes; then in the side of each case bore a hole near the clay; all these holes, or vents, must be so made that the fire of each case may act the same way; from these vents carry leaders to the top of the cone, and tie them together. When the rockets are to be fired, set them on a smooth table, and light the leaders in the middle, and all the cases will fire together and spin on the point of the cone.

These rockets may be made to rise like tourbillons, by

making the cases shorter, and boring four hole: under side of each at equal distances: this bei they are called *double tourbillons.*

Note.—All the vents in the under side of the ca be lighted at once; and the sharp point of the (off, at which place make it spherical.

WHEELS.

Wheel cases are made to any length, which ı ways depend on the size of the wheel; but must ceed the length of each angle.

Charge for wheel cases, from 2 oz. to 4 lb.

	lb.	oz.		
Meal-powder	4	0	Brimstone	
Saltpetre	1	0	Charcoal	

The filings in this composition may be varied by portion of sea-coal, glass-dust, saw-dust, &c. or s nation of the whole.

SLOW FIRE FOR WHEELS.

	lb.	oz.		
Saltpetre	0	4	Meal-powder . . .	
Brimstone	0	2	or,	

1 oz. of brimstone may be used with 1 oz. of anti

DEAD FIRE FOR WHEELS.

	oz.	dr.		
Saltpetre	4¼	0	Lapis-caliminaris . .	
Brimstone	0¼	0	Antimony	

Single Vertical Wheels.—There are different ı vertical wheels; some have their fells of a circul others of a hexagonal, octagonal, or decagonal f of any number of sides, according to the length cases you design for the wheel: the spokes being the nave, nail slips of tin, with their edges turne as to form grooves for the cases to lie in, from t of one spoke to that of another; then tie the case grooves head to tail, in the same manner as those

tal water-wheel, so that the cases successively fire from one another, will keep the wheel in an otation. Two of these wheels are very often fired r, one on each side of a building; and both lighted same time, and all the cases filled alike, to make eep time together; as they will, if made by the ng directions: in all the cases of both wheels, exe first, on each wheel drive two or three ladlesful fire, in any part of the cases; but be careful to ram ne quantity in each case, and in the end of one of es, on each wheel, you may ram one ladleful of e composition, which must be very lightly driven; y also make many changes of fire by this method. he hole in the nave of the wheel be lined with nd made to turn on a smooth iron spindle. On the this spindle let there be a nut, to screw off and on; ou have put the wheel on the spindle, screw on , which will keep the wheel from flying off. Let uth of the first case be a little raised. Vertical are made from 10 inches to 3 feet diameter, and e of the cases must differ accordingly; four-ounce ill do for wheels of 14 or 16 inches diameter, which proportion generally used. The best wood for of all sorts is a light and dry beech.

zontal Wheels.—They are best when their fells are circular; in the middle of the top of the nave must ntle, turned out of the same piece as the nave, two long, and equal in diameter to the bore of one of es of the wheel: there must be a hole bored up the of the nave, within half an inch of the top of the

The wheel being made, nail at the end of each (of which there should be six or eight) a piece of with a groove cut in it to receive the case. Fix pieces in such a manner that half the cases may upwards and half downwards, and that, when they d on, their heads and tails may come very nearly er: from the tail of one case to the mouth of the carry a leader, which should be secured with pasted

Besides these pipes, it will be necessary to put a neal-powder within the pasted paper, to blow off the that there may be no obstruction to the fire from the

cases. By means of these pipes the cases will successively take fire, burning one upwards and the other downwards. On the pintle fix a case of the same sort as those on the wheel; this case must be fired by a leader from the mouth of the last case on the wheel, which case must play downwards: instead of a common case in the middle, you may put a case of Chinese fire, long enough to burn as long as two or three of the cases on the wheel.

Horizontal wheels are often fired two at a time, and made to keep time like vertical wheels, only they are made without any slow or dead fire: 10 or 12 inches will be enough for the diameter of wheels with six spokes.

Spiral Wheels.—They are only double horizontal wheels and made thus: the nave must be about six inches long, and rather thicker than the single sort; instead of the pintle at top, make a hole for the case to be fixed in, and two sets of spokes, one set near the top of the nave, and the other near the bottom. At the end of each spoke cut a groove wherein you tie the cases, there being no fell; the spokes should not be more than two inches and a half long from the naves, so that the wheel may not be more than eight or nine inches diameter; the cases are placed in such a manner, that those at top play down, and those at bottom play up, but let the third or fourth case play horizontally. The case in the middle may begin with any of the others: six spokes will be enough for each set, so that the wheel may consist of 12 cases, besides that on the top: the cases six inches each.

Plural Wheels.—Plural Wheels are made to turn horizontally, and to consist of three sets of spokes, placed six at top, six at bottom, and four in the middle, which last must be a little shorter than the rest: let the diameter of the wheel be 10 inches; the cases must be tied on the ends of the spokes in grooves cut on purpose, or pieces of wood nailed on the ends of the spokes, with grooves cut in them as usual: in clothing these wheels, make the upper set of cases play obliquely downwards, the bottom set obliquely upwards, and the middle set horizontally. In placing the leaders, they must be managed so that the cases may burn thus, viz. first up, then down, then horizontal, and so on with the rest. But another change may

be made, by driving in the end of the eighth case two or three ladlesful of slow fire, to burn till the wheel has stopped its course; then let the other cases be fixed the contrary way, which will make the wheel run back again: for the case at top you may put a small gerbe; and let the cases on the spokes be short and filled with a strong brilliant charge.

Illuminated Spiral Wheels.—First have a circular horizontal wheel made two feet diameter, with a hole quite through the nave; then take three thin pieces of deal, three feet long each, and three-fourths of an inch broad each: one end of each of these pieces nail to the fell of the wheel, at an equal distance from one another, and the other end nail to a block with a hole in its bottom, which must be perpendicular to that in the block of the wheel, but not so large. The wheel being thus made, have a hoop planed down very thin and flat; then nail one end of it into the fell of the wheel, and wind it round the three sticks in a spiral line from the wheel to the block at top; on the top of each block fix a case of Chinese fire; on the wheel you may place any number of cases, which must incline downwards, and burn two at a time. If the wheel should consist of ten cases, you may let the illuminations and Chinese fire begin with the second cases. The spindle for this wheel must be a little longer than the cone, and made very smooth at top, on which the upper block is to turn, and the whole weight of the wheel to rest.

Double Spiral Wheels.—For these wheels, the block or nave must be as long as the height of the worms, or spiral lines, but must be made very thin, and as light as possible. In this block must be fixed several spokes, which must diminish in length, from the wheel to the top, so as not to exceed the surface of a cone of the same height. To the ends of these spokes nail the worms, which must cross each other several times: clothe these worms with illuminations, the same as those on the single wheels; but the horizontal wheel you may clothe as you like. At the top of the worm place a case of spur-fire, or an amber light.

Balloon Wheels.—They are made to turn horizontally; they must be made two feet diameter, without any spokes; *and very strong*, with any number of sides. On the top of a wheel range and fix in pots, three inches diameter and

seven inches high each, as many of these as there are cases on the wheel: near the bottom of each pot make a small vent; into each of these vents carry a leader from the tail of each case; load some of the pots with stars, and some with serpents, crackers, &c. As the wheels turn, the pots will successively be fired, and throw into the air a great variety of fires.

BALLOON CASES.

You must have an oval former, turned of smooth wood; then paste a quantity of brown, or cartridge paper, and let it lie till the paste has soaked all through; this done, rub the former with soap or grease, to prevent the paper from sticking to it; then lay the paper on in small slips, till you have made it one-third of the thickness of the shell intended. Having thus done, set it to dry; and when dry, cut it round the middle, leaving about one inch not cut, which will make the halves join much better than if quite separated. When you have some ready to join, place the halves even together, and let that dry; then lay on paper all over as before, every where equal. When the shell is thoroughly dry, burn a vent at top with a square iron.

Shells that are designed for stars only, may be made quite round, and the thinner they are at the opening the better; for if they are too strong, the stars are apt to break at the bursting of the shell. Balloons must always be made to go easy into the mortars.

MORTARS.

These mortars must be made of pasteboard with a small copper chamber at bottom, in which the powder is to be placed, on which the balloon is to be put. In the centre of the bottom of this chamber make a small hole a little down the foot: the hole must be met by another of the same size as the foot. Then putting a quick match, or touch-string, of touch-paper into the hole, your mortar will be ready to be fired.

To load Air Balloons with Stars, Serpents, &c. &c.—When you fill your shells, you must first put in the ser-

pents, rains, &c. or whatever they are composed of, then the blowing powder; but the shells must not be quite filled. All those things must be put in at the fuze hole, but marrons being too lage to go into the fuze hole, must be put in before the inside shell be joined. When the shells are loaded, glue and drive in the fuzees very tight. The number and quantities of each article for the different shells are as follow :

BALLOONS ILLUMINATED.

	oz.		oz.
Meal-powder - - - - - -	1	Powder for the mortar - -	2
Corn-powder - - - - - -	0½		

1 oz. driven or rolled stars, or as many as will fill the shell.

BALLOONS OF SERPENTS.

	oz.		oz.
Meal-powder - - - - - -	1	Powder for the mortar -	2½
Corn-powder - - - - - -	1		

Aigrettes.

Mortars to throw aigrettes are generally made of pasteboard, of the same thickness as balloon mortars, and two diameters and a half long in the inside from the top of the foot: the foot must be made of elm without a chamber, but flat at top, and in the same proportion as those for balloon mortars ; these mortars must also be bound round with a cord: sometimes eight or nine of these mortars, of about three or four inches diameter, are bound all together, so as to appear but one : but when they are made for this purpose, the bottom of the foot must be of the same diameter as the mortars, and only half a diameter high. The mortars being bound well together, fix them on a heavy solid block of wood. To load these mortars, first put on the inside bottom of each a piece of paper, and on it spread one ounce and a half of meal and corn powder mixed ; then tie the serpents up in parcels with quick-match, and put them in the mortar with their mouths downwards ; but take care the parcels do not fit too tight in the mortars, and that all the serpents have been well primed with powder wetted with spirit of wine. On the

top of the serpents in each mortar lay some paper or tow; then carry a leader from one mortar to the other all round, and then from all the outside mortars into that in the middle: these leaders must be put between the cases and the sides of the mortar, down to the powder at bottom: in the centre of the middle mortar fix a fire pump, or brilliant fountain, which must be open at bottom, and long enough to project out of the mouth of the mortar; then paste paper on the tops of all the mortars.

Mortars thus prepared are called a *nest of serpents*. When these mortars are to be fired, light the fire-pump, which when consumed will communicate to all the mortars at once by means of the leaders. For mortars of 8, 9, or 10 inches diameter, the serpents should be made in one and two ounce cases six or seven inches long, and fired by a leader brought out of the mouth of the mortar, and turned down on the outside, and the end of it covered with paper, to prevent the sparks of the other works from setting it on fire. For a six-inch mortar, let the quantity of powder for firing be two ounces; for an eight-inch, two ounces and three quarters; and for a ten inch, three ounces and three quarters. Care must be taken in these, as well as small mortars, not to put the serpents in too tight, for fear of bursting the mortars. These mortars may be loaded with stars, crackers, &c.

If the mortars, when loaded, are sent to any distance, or liable to be much moved, the firing powder should be secured from getting amongst the serpents, which would endanger the mortars, as well as hurt their performance. To prevent this, load the mortars thus: first put in the firing powder, and spread it equally about; then cut a round piece of blue touch-paper, equal to the exterior diameter of the mortar, and draw on it a circle equal to the interior diameter of the mortar, and notch it all round as far as that circle: then paste that part which is notched, and put it down the mortar close to the powder, and stick the pasted edge to the mortar: this will keep the powder always smooth at bottom, so that it may be moved or carried any where without receiving damage. The *large single* mortars are called *pots des aigrettes*

FIRE PUMPS, OR ROMAN CANDLES.

es for fire pumps are made as those for tourbillions; hey are pasted instead of being rolled dry. Having and dried your cases, fill them: first put in a little powder and then a star, on which ram, lightly, a la- two of composition, then a little meal-powder, and at a star, then again composition, and so on till you filled the case. Stars for fire-pumps should not be , but must be made either square, or flat and circular, a hole through the middle: the quantity of powder rowing the stars must increase as you come near the f the case; for, if much powder be at the bottom, it urst the case. The stars must differ in size in this er: let the star which you put in first be a little less he bore of the case; but let the next star be a little ;, and the third star a little larger than the second, on; let them increase in diameter till within two of p of the case, which two must fit in tight. As the load- fire-pumps is somewhat difficult, it will be necessary ke two or three trials before you depend on their rmance. When you fill a number of pumps, take not to put in each an equal quantity of charge een the stars, so that when they are fired, they may hrow up too many stars together. Cases for fire- s should be made very strong, and rolled on 4 or 8 e formers, 10 or 12 inches long each.

CHARGE.

	lb.	oz.	or	lb.	oz.
etre	5	0	Saltpetre	5	0
stone	1	0	Brimstone	2	0
powder	1½	0	Meal-powder	1	8
-dust	1	0	Glass-dust	1	8

AN ARTIFICIAL EARTHQUAKE.

x the following ingredients to a paste with water, then bury it in the ground, and in a few hours the will break open in several places.

	lb.	oz.		lb.	oz.
ur	4	0	Steel-dust	4	0

Chinese Fountains.

To make a Chinese fountain, you must have a perpendicular piece of wood seven feet long and two inches and a half square. Sixteen inches from the top, fix on the front a cross piece one inch thick, and two and a half broad, with the broad side upwards; below this, fix three more pieces of the same width and thickness, at sixteen inches from each other; let the bottom rail be five feet long, and the others of such a length as to allow the fire-pumps to stand in the middle of the intervals of each other. The pyramid being thus made, fix in the holes made in the bottom rail five fire-pumps, at equal distances; on the second rail, place four pumps; on the third, three; on the fourth, two; and on the top of the post, one; but place them all to incline a little forward, that, when they throw out the stars, they may not strike against the cross rails. Having fixed your fire-pumps, clothe them with leaders, so that they may be all fired together.

The Dodecahedron,

So called because it nearly represents a twelve-sided figure, is made thus; first have a ball turned out of some hard wood, 14 inches diameter: divide its surface into 14 equal parts, from which bore holes one inch and a half diameter, perpendicular to the centre, so that they may all meet in the middle: then let there be turned in the inside of each hole a female screw; and to all the holes but one must be made a round spoke five feet long, with four inches of the screw at one end to fit the holes; then in the screw-end of all the spokes bore a hole, five inches up, which must be bored slanting, so as to come out at one side, a little above the screw; from which cut a small groove along the spoke within six inches of the other end, where make another hole through to the other side of the spoke. In this end fix a spindle, on which put a small wheel of three or four sides, each side six or seven inches long; these sides must have grooves cut in them, large enough to receive a two or four ounce case. When these wheels are clothed, put them on the spindle, and at the end of each

spindle put a nut to keep the wheel from falling off. The wheels being thus fixed, carry a pipe from the mouth of the first case on each wheel, through the hole in the side of the spoke, and from thence along the groove, and through the other hole, so as to hang out at the screw-end about an inch. The spokes being all prepared in this manner, you must have a post, on which you intend to fire the work, with an iron screw in the top of it, to fit one of the holes in the ball: on the screw fix the ball; then in the top hole of the ball put a little meal-powder. and some loose quickmatch; then screw in all the spokes; and on one side of the ball bore a hole, in which put a leader, and secure it at the end: and the work will be ready to be fired. By the leader the powder and match in the centre is fired, which will light the match at the ends of the spokes all at once, whereby all the wheels will be lighted at once. There may be an addition to this piece, by fixing a small globe on each wheel, or one on the top wheel only. A grey charge will be proper for the wheel cases.

Stars with Points.

These stars are made of different sizes, according to the work for which they are intended; they are made with cases from one ounce to one pound, but in general with four-ounce cases, four or five inches long: the case must be rolled with paste, and twice as thick as that of a rocket of the same bore. Having rolled a case, pinch one end of it quite close: then drive in half a diameter o clay; and when the case is dry, fill it with composition two or three inches to the length of the case with which it is to burn: at the top of the charge drive some clay; as the ends of these cases are seldom pinched, they would be liable to take fire. Having filled a case, divide the circumference of it at the pinched end close to the clay into five equal parts; then bore five holes with a gimblet about the size of the neck of a common four ounce case, into composition: from one hole to the other carry a quickmatch, and secure it with paper: this paper must be put on in the manner of that on the end of the wheel-cases,

so that the hollow part, which projects from the end of the case, may serve to receive a leader from any other work, to give fire to the points of the stars. These stars may be made with any number of points.

Fixed Sun with a transparent Face.

To make the sun of the best kind, there should be two rows of cases, which will show a double glory, and make the rays strong and full. The frame or sun-wheel must be made thus; have a circular flat made very strong, 12 inches diameter; to this fix six strong flat spokes: on the front of these fix a circular fell, five feet diameter: within which fix another fell, the length of one of the sun-cases in diameter; within this fix a third fell whose diameter, must be less than the second by the length of one case and one third. The wheel being made, divide the fells into so many equal parts as there are to be cases (which may be done from 24 to 41): at each division fix a flat iron staple; these staples must be made to fit the cases, to hold them fast on the wheel; let the staples be so placed, that one row of cases may lie in the middle of the intervals of the other.

In the centre of the block of the sun drive a spindle, on which put a small hexagonal wheel, whose cases must be filled with the same charge as the cases of the sun: two cases of this wheel must burn at a time, and begin with them on the fells. Having fixed on all the cases, carry pipes of communication from one to the other, as you see in the figure, and from one side of the sun to the wheel in the middle, and from thence to the other side of the sun. These leaders will hold the wheel steady while the sun is fixing up, and will also be a sure method of lighting both cases of the wheel together. A sun thus made is called a *brilliant sun*, because the wood work is entirely covered with fire from the wheel in the middle, so that there appears nothing but sparks of brilliant fire: but if you would have a transparent face in the centre, you must have one made of pastboard of any size. The method of making a face is, by cutting out the eyes, nose, and mouth for the sparks of the wheel to appear through; but must

of this face, you may have one painted on oiled paper, or Persian silk, strained tight on a hoop; which hoop must be supported by three or four pieces of wire at six inches distance from the wheel in the centre, so that the light of it may illuminate the face. By this method may be shown in the front of a sun, VIVAT REX, cut in pasteboard, or Apollo painted on silk; but, for a small collection, a sun with a single glory, and a wheel in front, will be most suitable. Half pound cases, filled ten inches with composition, will be a good size for a sun of five feet diameter; but, if larger, the cases must be greater in proportion.

DETONATING WORKS.

WATERLOO CRACKERS.

Take a slip of cartridge paper, about three quarters of an inch in width, paste and double it; let it remain till dry and cut it into two equal parts in length, (No. 1 & 2) according to the following pattern:

No. 1.	Glass.	S	Glass.	No. 2.

Take some of the glass composition and lay it across the paper as in the pattern, and put about a quarter of a grain of fulminating silver in the place marked S, and while the glass composition is moist, put the paper marked No. 2, over the farthest row of glass. Over all, paste twice over the part that covers the silver a piece of paper; let it dry, and when you wish to explode it take hold of the two ends and pull them sharply from each other, and it will produce a loud report.

DETONATING GIRDLE.

Procure a piece of girth from 12 to 18 inches in length. Double it, and fold it down about 1½ inch, similar to the fold of a letter, and then turn back one end of the girt, and it will form two compartments. Then take some gum and dissolve it in water, boil it till it is quite melted, and very thick; add coarse powdered glass, sufficient to make it into a very thick paste, place two upright rows of the

glass composition in the inside of one of the folds, about as wide as the thickness of a lath, and as high as a half-crown laid flat; and when they are dry, sew the first fold together on the edge, and then the second at the opposite end, so that one end may be open. Then in the centre of the two rows put about a grain of fulminating silver, and paste a piece of cotton or silk over it. Make a hole at each end of the girdle, and hang it to a hook in the door-post, and the other hook on the door, observing to place the silk part so that it may come against the edge of the door when opened, which will cause a report as loud as a small cannon. The fulminating silver may be purchased at any of the operating chemists'.

DETONATING BALLS.

Procure some glass globes, between the size of a pea and a small marble, in which there must be a small hole; put into it half a grain of fulminating silver. Paste a piece of paper carefully over the ball to prevent the silver from escaping. When you wish to explode one, put it on the ground, and tread hard upon it, and it will go off with a loud noise. These balls may be made productive of much amusement in company, by placing a chair lightly on them, for whoever sits down upon them will cause them to explode. These globes may be procured at the barometer-makers.

THE DETONATING TAPE

Is made of binding, about three-eighths of an inch in width. Observe the same directions as given for the girdle; you may either explode it yourself, by taking hold of each end, and rolling the ends from each other sharply, or give one end to another, and pull together.

DETONATING CARDS.

Take a piece of card about three-fourths of an inch in breadth and 12 in length; slit it at one end, and place in the opening a quarter of a grain of fulminating silver; close the edges down with a little paste, and when dry you may use it, by lighting the end in the candle.

Having given the method by which these loud reports are *produced*, we shall mention some other effects to be

produced by the silver, capable of affording much amusement. For instance, by placing about a quarter of a grain of the silver in the midst of some tobacco in a pipe, or between the leaves of a segar, and closing the end again to prevent the powder from falling out; when lighted, it causes a loud explosion, for heat, as well as friction; will equally do.

Or take one third of a grain of fulminating silver; fold it up in a small piece of paper, and wrap it up in another piece: and paste it round a pin. These pins stuck in the wick of a candle make a very loud noise.

Fulminating silver may be also used in the following manner:—put half a grain in a piece of glass paper, and inclose then a piece of foil; put it in the bottom or side of a drawer, and on opening it or shutting it, it will immediately go off.

Put a quarter of a grain of fulminating silver into a piece of paper, and place it in the snuffers when quite cold; when the candle is snuffed it will go off.

AQUATIC FIREWORKS.

Works that sport in the water are much esteemed by most admirers of fireworks, particularly water-rockets; and as they seem of a very extraordinary nature to those who are unacquainted with this art, they merit a particular explanation.

Water Rockets.

They may be made from four ounces to two pounds. If larger they are too heavy; so that it will be difficult to make them keep above water without a cork float, which must be tied to the neck of the case; but the rockets will not dive so well with as without floats.

Cases for these are made in the same manner and proportion as sky-rockets, only a little thicher of paper. When you fill those which are driven solid, put in first one ladle-full of slow fire, then two of the proper charge, and on that one or two ladles of sinking charge, then the proper charge, then the sinking charge again, and so on,

till you have filled the case with three diameters; then drive on the composition one ladlefull of clay; through which make a small hole to the charge; then fill the case, within half a diameter, with corn powder, on which turn down two or three rounds of the case in the inside; then pinch and tie the end very tight; having filled the rockets according to the above directions); dip their ends in melted rosin or sealing-wax, or else secure them well with grease. When you fire those rockets, throw in six or eight at a time; but, if you would have them all sink or swim at the same time, you must fill them with an equal quantity of composition, and fire them all together.

Pipes of Communication for Water.

They may be usedunder water; butmust be a little thicker in the paper than those for land. Having rolled a suffiicent number of pipes, and kept them till dry; wash them over with drying oil, and set them to dry; but when you oil them, leave about an inch and a half at each end dry for joints; as if they were oiled all over, when you come to join them, the paste would not stick where the paper is greasy; after the leaders are joined, and the paste dry, oil the joints. These pipes will lie many hours under water, without receiving any damage.

Horizontal Water-Wheels.

To make horizontal wheels for the water, first get a large wooden bowl without a handle, then have an eight-sided wheel made of a flat board 18 inches diameter, so that the length of each side may be nearly seven inches: in all the sides cuta groove for thecases to lie in.This wheel being made nail it on the top of the bowl; then take four eight-ounce cases, filled with a proper charge, each about six inches in length. Now to clothe the wheel with these cases, get some whitish-brown paper, and cut it into slips four or *five inches* broad and seven or eight long; these slps being *pasted all* over on one side, take one of the cases, and roll *ne of the* slips of paper about an inch and a half on its end

so that there will remain about two inches and a half of the paper hollow from the end of the case: tie this case on one of the sides of the wheel, near the corners of which must be holes bored, through which put the pack-thread to tie the cases; having tied on the first case at the neck and end, put a little meal-powder in the hollow paper; then paste a slip of paper on the end of another case, the head of which put into the hollow paper on the first, allowing a sufficient distance from the tail of one to the head of the other for the pasted paper to bend without tearing: tie on the second case as you did the first; and so on with the rest, except the last, which must be closed at the end, unless it is to communicate to any thing on the top of the wheel, such as fire-pumps or brilliant fires, fixed in holes cut in the wheel, and fired by the last or second case, as the fancy directs; six, eight, or any number, may be placed on the top of the wheel, provided they be not too heavy for the bowl.

Before tying on the cases, cut the upper part of all their ends, except the last, a little shelving, that the fire from one may play over the other, without being obstructed by the case. Wheel cases have no clay driven in their ends, nor pinched, but are always left open, only the last, or those which are not to lead fire, which must be well secured.

Water-Mines.

For water mines you must have a bowl with a wheel on it, made in the same manner as the water-wheel; only in its middle there must be a hole, of the same diameter as that of the intended mine. These mines are tin pots, with strong bottoms, and a little more than two diameters in length: the mine must be fixed in the hole in the wheel, with its bottom resting on the bowl; then loaded with serpents, crackers, stars, small water-rockets, &c. in the same manner as pots of aigrettes; but in their centre fix a case of Chinese fire, or a small gerbe, which must be lighted at the beginning of the last case on the wheel. These wheels are to be clothed as usual.

Fire-Globes for the Water.

Bowls for water-globes must be very large, and the wheels on them of ten sides: on each side nail a piece of wood four inches long; and on the outside of each piece cut a groove, wide enough to receive about one-fourth of the thickness of a four-ounce case: these pieces of wood must be nailed in the middle of each face of the wheel, and fixed in an oblique direction, so that the fire from the cases may incline upwards: the wheel being thus prepared, tie in each groove a four-ounce case filled with a grey charge; then carry a leader from the tail of one case to the mouth of the other.

Globes for these wheels are made of two tin hoops, with their edges outwards, fixed one within the other, at right angles. The diameter of these hoops must be rather less than that of the wheel. Having made the globe, drive in the centre of a wheel an iron spindle, which must stand perpendicular, and its length be four or six inches more than the diameter of the globe.

The spindle serves for an axis, on which is fixed the globe, which must stand four or six inches from the wheel; round one side of each hoop must be soldered little bits of tin, two inches and a half distance from each other; which pieces must be two inches in length each, and only fastened at one end, the other ends being left loose, to turn round the small portfires, and hold them on: these portfires must be made of such a length as will last out the cases on the wheel. There need not be any portfires at the bottom of the globe within four inches of the spindle; as they would have no effect, but to burn the wheel: all the portfires must be placed perpendicularly from the centre of the globe, with their mouths outwards; and must be clothed with leaders, so as all to take fire with the second case of the wheel; and the cases must burn two at a time, one opposite to the other. When two cases of a wheel begin together, two will end together; therefore the two opposite end cases must have their ends pinched and secured from fire. The method of firing such wheels is, by carrying a leader from the mouth of one of the first cases to that of the other; and the leader being burnt through the middle, will give fire to both at the same time.

Odoriferous Water Balloons.

THEY are made in the same manner as air-balloons, but very thin of paper, and in diameter one inch and three-fourths, with a vent of half an inch diameter. The shells being made, and quite dry, fill them with any of the following compositions, which must be rammed in tight; these balloons must be fired at the vent, and put into a bowl of water. Odoriferous works are generally fired in rooms.

Composition I. Saltpetre two ounces, flour of sulphur one ounce, camphor half an ounce, yellow amber half an ounce, charcoal-dust three-fourths of an ounce, salt of benjamin half an ounce, all powdered very fine and well mixed.

II. Saltpetre 12 ounces, meal-powder three ounces, frankincense one ounce, myrrh half an ounce, camphor half an ounce, charcoal three ounces, all moistened with the oil of spike.

III. Saltpetre two ounces, sulphur half an ounce, antimony half an ounce, amber half an ounce, cedar raspings one-fourth of an ounce, all mixed with the oil of roses and a few drops of bergamot.

IV. Saltpetre four ounces, sulphur one ounce, saw-dust of juniper half an ounce, saw-dust of cypress one ounce, camphor one-fourth of an ounce, myrrh two drams, dried rosemary one-fourth of an ounce, all moistened a little with the oil of roses.

N. B. Water rockets may be made with any of the above compositions, with a little alteration, to make them weaker or stronger, according to the size of the cases.

A Sea-fight with small Ships and a Fire-ship.

HAVING procured four or five small ships, of two or three feet in length, make a number of small reports, which are to serve for guns. Of these range as many as you please on each side of the upper decks; then at the head and stern of each ship fix a two-ounce case, eight inches long, filled with a slow port-fire composition; but take care to place it in such a manner that the fire may fall in the water, and not burn the rigging. in these cases bore holes at equal distances

from one another, but make as many in each case as half the number of reports, so that one case may fire the guns on one side, and the other those on the opposite. The method of firing the guns is, by carrying a leader from the holes in the cases to the reports on the decks; you must make these leaders very small, and be careful in calculating the burning of the slow fire in the regulating cases, that more than two guns be not fired at a time. When you would have a broadside given, let a leader be carried to a cracker, placed on the outside of the ship; which cracker must be tied loose, or the reports will be too slow: in all the ships put artificial guns at the port-holes. Reports for these and similar occasions are made by filling small cartridges with grained powder, pinching them close at each end, and. when used, boring a hole in the side to which is placed a match or leader for firing them.

Having filled and bored holes in two port-fires for regulating the guns in one ship, make all the rest exactly the same; then, when you begin the engagement, light one ship first, and set it a sailing, and so on with the rest, sending them out singly, which will make them fire regularly, at different times, without confusion; for the time between the firing of each gun will be equal to that of lighting the slow fires.

The fire-ship may be of any size; and need not be very good, for it is always lost in the action. To prepare a ship for this purpose, make a portfire equal in size with those in the other ships, and place it at the stern; in every port place a large portfire, filled with a very strong composition, and painted in imitation of a gun, and let them all be fired at once by a leader from the slow fire, within two or three diameters of its bottom; all along both sides, on the top of the upper deck, lay star composition about half an inch thick and one broad, which must be wetted with thin size, then primed with meal powder, and secured from fire by pasting paper over it; in the place where you lay this composition, drive some little tacks with flat heads, to hold it fast to the deck: this must be fired just after the sham guns, and when burning will show a flame all round the ship: at the head take up the decks, and put in a tin mortar loaded with crackers, which mortar must be fired by

pipe from the end of the slow fire; the firing of this mortar will sink the ship, and make a pretty conclusion. The regulating port-fire of this ship must be lighted at the same time with the first fighting ship.

Having prepared all the ships for fighting, we shall next proceed with the management of them when on the water. At one end of the pond, just under the surface of the water, fix two running blocks, at what distance you choose the ships should fight; and at the other end of the pond, opposite to each of these blocks, under the water, fix a double block; then on the land by each of the double blocks, place two small windlasses; round one of them turn one end of a small cord, and put the other end through one of the blocks; then carry it through the single one at the opposite end of the pond, and bring it back through the double block again, and round the other windlass; to this cord, near the double block, tie as many small strings as half the number of the ships at any distance; but these strings must not be more than two feet long each: make fast the loose end of each to a ship, just under her bowsprit; for if tied to the keel, or too near the water, it will overset the ship. Half the ships being thus prepared, near the other double block fix two more windlasses, to which fasten a cord, and to it tie the other half of the ships as before: when you fire the ships, pull in the cord with one of the windlasses, to get all the ships together; and when you have set fire to the first, turn that windlass which draws them out, and so on with the rest, till they are all put in the middle of the pond; then by turning the other windlass, you will draw them back again; by which method you may make them change sides, and tack about backwards and forwards at pleasure. For the fire-ship fix the blocks and windlasses between the others; so that when she sails out, she will be between the other ships: you must not let this ship advance till the guns at her ports take fire.

To fire Sky-Rockets under Water.

You must have stands made as usual, only the rails must be placed flat instead of edgewise, and have holes in them

for the rocket to go through: for if they were hung upon hooks, the motion of the water would throw them off: the stands being made, if the pond is deep enough, sink them at the sides so deep, that, when the rockets are in, their heads may just appear above the surface of the water; to the mouth of each rocket fix a leader, which put through the hole with the stick; then a little above the water must be a board, supported by the stand, and placed along one side of the rockets; then the ends of the leaders are turned up through holes made in this board exactly opposite the rockets. By this means you may fire them singly or all at once. Rockets may be fired by this method in the middle of a pond, by a Neptune, a swan, a water-wheel, or any thing else you choose.

Neptune in his Chariot.

To represent Neptune in his chariot, you must have a Neptune (made of wood, or basket work) as big as life, fixed on a float large enough to bear his weight; on which must be two horses heads and necks, so as to seem swimming. For the wheels of the chariot, there must be two vertical wheels of black fire, and on Neptune's head a horizontal wheel of brilliant fire, with all its cases, to play upwards. When this wheel is made, cover it with paper or pasteboard, cut and painted like Neptune's coronet; then let the trident be made without prongs, but instead of them, fix three cases of a weak grey charge, and on the mouth of each fix a short case, of the same diameter, filled with the white-flame composition enough to last out all the cases upon the wheels: these short cases must be open at bottom, that they may light the brilliant fires: for the horses eyes put small port-fires, and in each nostril put a small case half filled with grey charge, and the rest with port-fire composition.

If Neptune is to give fire to any building on the water; at his first setting out, the wheels of the chariot, and that on his head, with the white flames on the horses heads, and the port-fires in their eyes and nostrils, must all be lighted at once; then from the bottom of the white flames

leader to the trident. As Neptune is to advance help of a block and cord, you must manage it so as let him turn about, till the brilliant fires on the ınd the trident begin; for it is by the fire from the which plays almost upright) that the building, or s lighted; which must be thus prepared. From the of the case which is to be first fired, hang some uick-match to receive the fire from the horses. Neptune is only to be shown by himself, without fire to any other works, let the white flames on the be very short, and not to last longer than one case wheel, and let two cases of each wheel burn at a

Swans and Ducks in Water.

u would have swans or ducks discharge rockets water, they must be made hollow, and of paper, :d with small water rockets, with some blowing to throw them out: but if this is not done, they made of wood, which will last many times. Having ıd painted some swans, fix them on floats: then in ces where their eyes should be, bore holes two leep inclining downwards, and wide enough to a small port-fire; the port-fire cases for this purpose : made of brass, two inches long, and filled with a ıght charge. In the middle of one of these cases little hole; then put the port-fire in the eye-hole of n, leaving about half an inch to project out; and ther eye put another port-fire, with a hole made in in the neck of the swan, within two inches of one yes, bore a hole slantwise, to meet that in the :; in this hole put a leader, and carry it to a water- that must be fixed under the tail with its mouth s. On the top of the head place two one-ounce ɔur inches long each, driven with brilliant fire; one : cases must incline forwards, and the other back- these must be lighted at the same time as the ɔcket; to do which, bore a hole between them in f the swan's head, down to the hole in the port-fire, ı carry a leader: if the swan is filled with rockets,

they must be fired by a pipe from the end of the water-rocket under the tail. When you set the swan a swimming, light the two eyes.

Water Fire-Fountains.

To make a fire-fountain for the water, first have a float made of wood, three feet diameter; then in the middle fix a round perpendicular post, four feet high, and two inches diameter; round this post fix three circular wheels made of thin wood, without any spokes. The largest of these wheels must be placed within two or three inches of the float, and must be nearly of the same diameter. The second wheel must be two feet two inches diameter, and fixed at two feet distance from the first. The third wheel must be one foot four inches diameter, and fixed within six inches of the top of the post: the wheels being fixed, take 18 four or eight-ounce cases of brilliant fire, and place them round the first wheel with their mouths outwards, and inclining downwards; on the second wheel place 13 cases of the same, and in the same manner as those on the first; on the third, place eight more of these cases, in the same manner as before, and on the top of the post fix a gerbe; then clothe all the cases with leaders, so that both they and the gerbe may take fire at the same time. Before firing this work, try it in the water to see whether the float is properly made, so as to keep the fountain upright.

THE END.

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